PRACTICAL WIRELESS

JULY 1974
25p

THE POPULAR NEW ELECTRONIC GAME

TELE-TENNIS

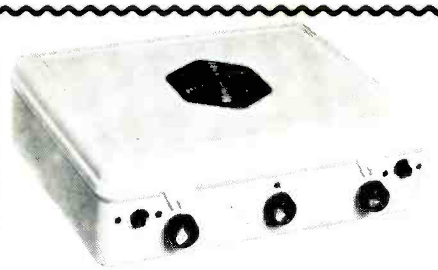
PART ONE

PLAYED ON THE TELEVISION SCREEN

ALSO:-

THE 'SEVERN' 4-BAND PORTABLE

GENERAL PURPOSE PREAMPLIFIER



NEW EDU-KIT MAJOR

Completely Solderless Electronic Construction Kit
Build these projects without soldering iron or solder

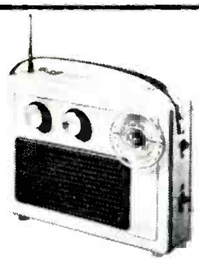
- ★ 4 Transistor Earpiece Radio.
- ★ Signal Tracer.
- ★ Signal Injector.
- ★ Transistor Tester NPN-PNP.
- ★ 4 Transistor Push Pull Amplifier.
- ★ 5 Transistor Push Pull Amplifier.
- ★ 7 Transistor Loudspeaker Radio MW/LW.
- ★ 5 Transistor Short Wave Radio.
- ★ Electronic Metronome.
- ★ Electronic Noise Generator
- ★ Batteryless Crystal Radio.
- ★ One Transistor Radio.
- ★ 2 Transistor Regenerative Radio.
- ★ 3 Transistor Regenerative Radio.
- ★ Audible Continuity Tester.
- ★ Sensitive Pre-Amplifier.

Total Building Costs
£7·23 P P & Ins. 44p (Overseas P & P £1·85)
(+ 10% VAT 72p)

Components Include: 24 Resistors ● 21 Capacitors ● 10 Transistors ● 3¼" Loudspeaker ● Earpiece ● Mica Baseboard ● 3 12-way connectors ● 2 Volume controls ● 2 Slider Switches ● 1 Tuning Condenser ● 3 Knobs ● Ready Wound MW/LW/SW Coils ● Ferrite Rod ● 6½ yards of wire ● 1 Yard of sleeving etc. ● Parts Price List and Plans 50p. (Free with parts).

NEW ROAMER NINE

WITH V.H.F. INCLUDING AIRCRAFT



Nine Transistors. 9 Tuneable wavebands as Roamer Ten Built in ferrite rod aerial for MW/LW. Retractable chrome-plated telescopic aerial for VHF and SW. Push Pull output using 600 mW transistors. 9 Transistors and 3 diodes, tuning condenser with V.H.F. section, separate coil for aircraft, moving coil loudspeaker, volume ON/OFF and wavechange controls. Attractive all white case with red grille and carrying strap. Size 9½" × 7" × 2½" approx. Parts Price List and Plans 30p (Free with parts).

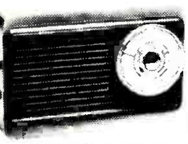
Total Building Costs **£6·95** P P & Ins. 44p (Overseas P & P £1·85)
(+ 10% VAT 69p)

POCKET FIVE

3 Tunable wavebands. M.W. L.W. and Trawler Band. 7 stages, 5 transistors and 2 diodes, supersensitive ferrite rod aerial, moving coil loudspeaker, attractive black and gold case. Size 5½" × 1¼" × 3½" approx. Plans and Parts Price List 15p (Free with parts).

Total Building Costs **£2·28** P P & Ins. 26p (+10% VAT 22p) (Overseas P & P £1·25)

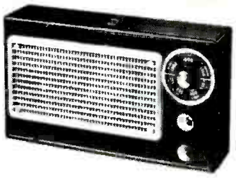
TRANSONA FIVE



Wavebands, transistors and speaker as Pocket Five. Larger Case with Red Speaker Grille and Tuning Dial. Plans and Parts Price List 15p (Free with parts).

Total Building Costs **£2·50** P P & Ins. 26p
(+10% VAT 25p) (Overseas P & P £1·25)

NEW Everyday Series



Build this exciting New series of designs

E.V.5. 5 Transistors and 2 diodes. MW/LW. Powered by 4½ volt Battery. Ferrite rod aerial, tuning condenser, volume control, and loudspeaker. Attractive case with red speaker grille. Size 9" × 5½" × 2½" approx. Parts Price List and Plans 15p. Free with parts.

Total Building costs **£2·73** P P & Ins. 30p (+ 10% VAT 27p) (Overseas P & P £1·25)

E.V.6. Case and looks as above. 6 Transistors and 3 diodes. Powered by 9 volt battery. Ferrite rod aerial, 3" loudspeaker, etc., MW/LW coverage. Push Pull output. Parts Price List and Plans 15p. Free with parts.

Total Building Costs **£3·60** P P & Ins. 30p (+ 10% VAT 36p) (Overseas P & P £1·25)

E.V.7. Case and looks as above. 7 Transistors and 3 diodes. Six wavebands. MW/LW, Trawler Band, SW1, SW2, SW3, powered by 9 volt battery. Push Pull output. Telescopic aerial for short waves. 3" Loudspeaker. Parts Price List and Easy Build Plans 20p. Free with parts. Overseas P & P £1·05.

Total Building Costs **£4·08** P P & Ins. 31p Overseas P & P £1·85 (+ 10% VAT 40p)

ROAMER EIGHT Mk I

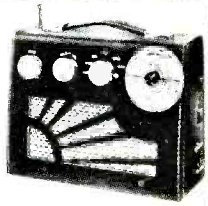
NOW WITH VARIABLE TONE CONTROL

7 Tunable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Built in Ferrite Rod Aerial for MW and LW. Retractable chrome plated Telescopic aerial for Short Waves. Push pull output using 600mW transistors. Car aerial and Tape record sockets. Selectivity switch. 8 transistors plus 3 diodes. Latest 4" 2 watt ferrite magnet loudspeaker. Air spaced ganged tuning condenser. Volume/on/off, tuning, wave change and tone controls. Attractive case in rich chestnut shade with gold blocking. Size 9 × 7 × 4in. approx. Easy to follow instructions and diagrams. Parts price list and plans 25p (FREE with parts).

Total building costs Overseas P & P £1·85) **£6·98** P P & Ins. 47p (+ 10% VAT 69p)

ROAMER TEN

WITH VHF INCLUDING AIRCRAFT



10 Transistors. Latest 4" 2 watt Ferrite Magnet Loudspeakers. 9 Tunable Wavebands, MW1, MW2, LW, SW1, SW2, SW3, Trawler Band, VHF and Local Stations also Aircraft Band. Latest 4" 2 watt ferrite magnet loudspeaker.

Built in Ferrite Rod Aerial for MW/LW. Retractable chrome plated 7 section Telescopic Aerial, can be angled and rotated for peak short wave and VHF listening. Push Pull output using 600mW Transistors. Car Aerial and Tape Record Sockets. 10 Transistors plus 3 Diodes. Ganged Tuning Condenser with VHF section. Separate coil for Aircraft Band. Volume on/off. Wave Change and tone Controls. Attractive Case in black with silver blocking. Size 9" × 7" × 4". Easy to follow instructions and diagrams. Parts price list and plans 30p (FREE with parts).

Total building costs (Overseas P & P £1·85) **£8·50** P P & Ins. 52p
(+ 10% VAT 85p)

"EDU-KIT"

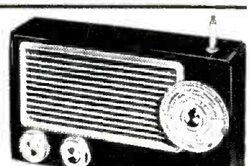
Build Radios, Amplifiers, etc., from easy stage diagrams.

Five units including master unit to construct.

Components include:
Tuning Condenser: 2 Volume Controls: 2 Slider Switches: Fine Tone 3" Moving Coil Speaker: Terminal Strip: Ferrite Rod Ariel: Battery Clips: 4 Tag Boards: 10 Transistors: 4 Diodes: Resistors: Capacitors: Three ¼" Knobs. Units once constructed are detachable from Master Unit, enabling them to be stored for future use. Ideal for Schools, Educational Authorities and all those interested in radio construction.
Parts price list and plans 25p (FREE with parts).

Total building costs **£5·50** P P & Ins. 33p (Overseas P & P £1·85)
(+ 10% VAT 55p)

TRANS EIGHT 8 TRANSISTORS and 3 DIODES



6 Tunable Wavebands: MW, LW, SW1, SW2, SW3 and Trawler Band. Sensitive ferrite rod aerial for M.W. and L.W. Telescopic aerial for Short Waves. 3in. Speaker. 8 improved type transistors plus 3 diodes. Attractive case in black with red grille, dial and black knobs with polished metal inserts. Size 9 × 5½ × 2½in. approx. Push pull output. Battery economiser switch for extended battery life. Ample power to drive a larger speaker. Parts price list and plans 25p (FREE with parts).

Total building costs **£4·48** P P & Ins. 33p
(+ 10% VAT 44p) (Overseas P & P £1·25)

ROAMER SIX

CASE AND LOOKS AS TRANS-EIGHT

6 Tunable Wavebands: MW, LW, SW1, SW2, Trawler band plus an extra Medium waveband for easier tuning of Luxembourg, etc. Sensitive ferrite rod aerial and telescopic aerial for Short Waves. 3in. Speaker 8 stages—6 transistors and 2 diodes. Attractive black case with red grille, dial and black knobs with polished metal inserts. Size 9 × 5½ × 2½in. approx. Plans and parts price list 25p (FREE with parts).

Total building costs **£3·98** P P & Ins. 31p (Overseas P & P £1·85)
(+ 10% VAT 39p)

RADIO EXCHANGE LTD

★ Callers side entrance "Lavells" shop.
★ Open 10–1, 2.30–4.30, Mon. Fri. 9–12 Sat.

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Tel.: 0234 52367. Reg. No. 788372.

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Address ....

(Dept. PW24.)

PRACTICAL WIRELESS

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JULY 1974

BRITAIN'S PREMIER MAGAZINE FOR THE DO-IT-YOURSELF RADIO AND ELECTRONICS CONSTRUCTOR

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BACK NUMBERS
We regret that we are unable to supply back numbers of Practical Wireless. Readers are recommended to enquire at a public library to see copies. Requests for specific back numbers of *Practical Wireless* and *Television* only can be published in our CQ Column.

● NEWS & COMMENT

● CONSTRUCTIONAL

● OTHER FEATURES

RSC 100watt DISCO SYSTEM

Units listed below
(a) DISCOMASTER TWIN T. TABLE CONSOLE with integral 100W amp.
(b) PAIR OF HI-FI HEAD-PHONES
(c) MATCHING DYNAMIC 'MIKE' (attached to h'phone)
(d) PAIR 50 WATT SPEAKERS Black Rexine covered Cabinets Size approx. 18" × 18" × 8"
(a) (b) (c) & (d) Carr. £3·00 **£149·95**
Terms Deposit £19·95 & 19 mthly. payments of £7·87 (Total £169·48).

RSC TDI DISCO CONSOLE

Incorporating twin Garrard SP25 or BSR MP60 type turntables and Sonotone or Acos Cartridges with diamond stylii. Separate Vol. controls for each turntable. Also MONITORING FACILITIES, plus Treble and Bass Controls. Separate input for 'mike' with vol. control switch. Black Vynide covered Cabinet with lid, see illustration on left. Or Dep. £7·99 and 9 mthly pymts £7·99 (Total £79·90) **£69·95** Carr. £1·50

DISCOMASTER TWIN TURNTABLE POWER CONSOLE

Garrard SP25 or McDonald MP60 turntables. Sonotone or Acos cartridges with diamond styli. Facilities as TDI Console but with built-in 100 watt Power Amplifier, complete with lid. Or Deposit £11·48 and 9 monthly payments £11·48 (Total £114·80) **£99·95**

R.S.C. COLUMN SPEAKERS

IDEAL FOR VOCALISTS AND PUBLIC ADDRESS

All types 15 Ohms covered in Rexine and Vynair

TYPE C132 30-40 WATTS Fitted two exceptionally efficient, low feedback howl characteristic high flux 13" x 8" 20 watt speakers. Terms: Dep. £2·95 and 8 m'thly payments £2·51 (Total £23·03) Carr. 65p. **£19·95**

TYPE C3/70 70 WATTS. Fitted three 12" 25 watt Highly sensitive high flux speakers with high power voice coils. Size approx. 54" × 14" × 11". Dep. £9·95 & 8 mthly pymts. £4·31 (Total £44·43) Carr. 85p **£39·95**

FANE ULTRA HIGH POWER LOUDSPEAKERS

All power ratings are R.M.S. continuous. 2 YEARS' GUARANTEE High flux ceramic magnets. ALL CARRIAGE FREE.

'POP' 100 18" 100 Watt 14,000 gauss 8/15Ω **£29·70** Dep: £3·80 and 8 mthly payments £3·80 (Total £34·20)

'POP' 60 15" 60 Watt 14,000 gauss 8/15Ω **£16·95** Dep. £2·17 and 8 monthly payments. £2·17 (Total £19·53)

'POP' 50 12" 50 Watt 13,000 gauss 15Ω **£12·99** Dep £1·95 and 8 monthly payments £1·71 (Total £15·63) PAIR SUITABLE ALL PURPOSES

FOR BASS GUITAR, ELECT. ORGAN, ETC.

NEW 'POP' 55 12" 60W

Gauss 15,000 Imp 8/15Ω Or Dep £2·45 & 8 monthly payments £2 (Total £18·45) **£15·95** Carr. Free

FANE SPEAKERS 'POP' 25/2 12 in. 30 WATT

Dual Cone 15 Ω (for uses other than Bass Guitar or Electronic Organ). Carr. free **£8·99** CREDIT TERMS (PAIRS ONLY) Dep. £2·80 & 8 mthly pymts. £2·30 (Total £21·20).

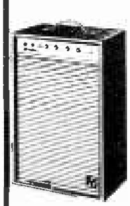
ALL RSC PRICES INCLUDE VAT

INTEREST CHARGES REFUNDED on Credit Purchases settled in 3 months

FANE CRESCENDO SPEAKERS

Full range available at ALL BRANCHES

MINSTREL 8W GUITAR AMP.



Incorporating Tremolo and 13" × 8" or 10" Speaker. Output 8 watts R.M.S. Continuous. 3 Jack Inputs for Microphone and Instrument. Mains Neon Controls: Volume, Tone, Tremolo Speed Tremolo Intensity.
Terms: Deposit £2·95 and 8 monthly payments £2·39 (Total £22·07). Carr. free **£19·95**

GROUP EQUIPMENT PACKAGE OFFERS

F.A.L. PHASE 50 MK. III AMPLIFIER £39·93
PR. FANE POP 25/2 30W L/SPEAKERS £17·98
£57·91
Terms: Deposit £6·77 and 8 monthly payments of £6·77 (Total £60·93)
PACKAGE PRICE **£52·95** carr. £1·10

F.A.L. PHASE 50 MK.III AMPLIFIER £39·93
PR. FANE POP 50 L/SPEAKERS £25·98
£65·91
Terms: Deposit £20 and 12 monthly payments of £3·90 (Total £66·80)
PACKAGE PRICE **£59·99** carr. £1·10

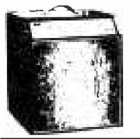
F.A.L. PHASE 50 AMPLIFIER £39·93
PAIR L12/20 SPKRS (in Cabinets) £25·90
£65·83
Terms: Deposit £20·00 and 12 monthly payments £3·90 (Total £66·80)
PACKAGE PRICE **£59·99** carr. £2·00

FAL PHASE 50 Mk. III AMPLIFIER 50 WATT

Solid state. 4 Separately controlled inputs Plus master vol. control. Ind. Bass and Treble Controls. Protective Circuitry against serious output overloading. Output for Speaker/s 3 to 30 ohms. Size 17" × 7" × 7½". 200-250v. A.C. mains. Output 50 watts music rating. Or deposit £9·93 & 8 monthly payments £4·31. Total £44·41. **£39·93**

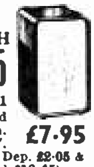
RSC PHANTOM '50'

Combined 50W Amplifier and 12in. Loudspeaker.



For Lead Guitar, Mic., Gram, Radio, Tape (Not for use with Bass instruments). Inc. 3 inputs and 2 vol. controls plus Treble, Bass and Presence. Output Jack for additional 15 ohm Speaker. Attractively finished in black with silver-finished fascia and trimmings. Compact size. Fitted carrying handle. Terms: Deposit £6·39 and 8 monthly payments £6·39 (Total £57·51). Carr. £1·50 SAE for leaflet UK Mainland **ONLY £49·95** SPECIAL PRICE for limited period

HIGH QUALITY LOUDSPEAKER UNITS



ALL TWO TONE REXINE AND VYNAIR FINISH
L125 50 WATT Fitted pair of 12" 50 watt high flux speakers for conservative rating. Impedance 8-15 ohms. Carr. £1·50 **£39·95**
Or deposit £7·95 and 8 monthly payts. of £4·72. Total £45·71

L12/20 12" 25 WATT 13,000 lines 15 ohms Terms for Pairs. Dep £3·32 & 8 mthly pymts £3·32 (Total £29·88) **£12·95** Carr. 55p.

L12/10 10-15 Watt Veneered cabinet 12" unit 8-15 ohm. Approx. 14" × 14" × 9". **£7·95** Carr. 65p. Terms for Pairs. Dep. £2·05 & 8 mthly pymts £2·05 (Total £18·45).

REGENT 50X AMPLIFIER

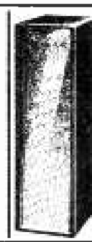
A powerful high quality unit for lead, rhythm, guitar, vocalists, gram, radio, tape. Peak Output rating. Not for Bass Guitar.
★ Two extra heavy duty 12in. speakers.
★ Four Jack inputs and two Volume Controls for instant use of up to four pick-ups or "mikes". Bass and Treble controls. Send S.A.E. for leaflet. Credit Terms: Deposit £7·99. & 9 monthly payments of £7·99 (Total £79·90). Carr. £2·50. **£69·95**
REGENT 50B for Bass Guitar and general purposes. Or Dep. £9·19 & 9 mthly pymts £9·19. (Total £91·90). Carr. £2·50 **£79·95**

GP30 AMPLIFIER

For Guitar, Vocal or Instrumental Group

A 4 input, 2 vol. control Hi-Fi 30 watt unit with Separate Bass and Treble controls. Current valves. Peak output rating. Strong Rexine covered cabinet with handles. Attractive black/silver P.V.C. fascia. Neon indicator. For 200-250v. A.C. mains. For 3 or 15 ohm speakers. Send S.A.E. for leaflet.
Terms: Deposit £3·58 and 8 monthly payments of £3·58 (Total £32·22). **£27·95** Carr. 75p

C4/100 HEAVY DUTY COLUMN SPEAKERS



Suitable for Public Address or Vocal and Instrumental Groups. Fitted four 12" 50 watt speakers. Robust attractive Vynide covered cabinet 58" × 16" × 10" approx.
SPECIAL PRICE Carr £1·50 **£59·95**
Or Dep. £20 and 12 mthly pymts £3·90 (Total £66·80.

NOW SEVEN NEW BRANCHES BOLTON, COVENTRY DONCASTER, STOCKPORT SUNDERLAND, PRESTON and NOTTINGHAM

NEW LARGER PREMISES AT HULL, DARLINGTON, NEWCASTLE & DERBY

Barclaycard and Access accepted

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SUPPLIERS TO GOVT. DEPTS. H.M. FORCES. EDUCATION AUTHORITIES & HOSPITALS. Etc.

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NEWCASTLE UPON TYNE 24 Newgate Shopping Centre (Closed Wed.). Tel. 21469
NOTTINGHAM 19/19A Market Street (Closed Thurs.). Tel. 48068
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HUGE DISCOUNTS

ON LEADING BRAND HI-FI — **All R.S.C. Prices include VAT**

*Full labour and material guarantees for 12 months
LOW DEPOSIT TERMS OVER 8 MONTHS

	List Price	RSC Price
Wharfedale 150 ISODYNAMIC H/PHONES	£24·05	£17·95
WHARFEDALE DENTON	£43·09 Pr.	£29·95
WHARFEDALE LINTON	£53·35 Pr.	£35·95
LEAK 150 SPEAKERS	£51·30 Pr.	£31·95
LEAK 250 SPEAKERS	£60·86 Pr.	£42·50
LINEAR 202 AMPLIFIER	£39·93	£24·75
Wharfedale Denton Tuner/Amp	£95	£54·95

ALSO SHURE CARTRIDGES, BASF TAPE ETC.
Prices shown correct at 24th May 1974

AKAI TAPE UNITS

All £1 carr.

		Rec. Price
GXC 36D	£64·95	£112·75
GXC 38D	£99·95	£139·90
GXC 36	£89·95	£125·50
GXC 40T	£135·95	£189·50
GXC 46D	£114·95	£160·50
GXR 82D	£89·95	£124·90
4000 DS	£94·95	£132·50
1721 L	£86·95	£120·75
CR 81D	£69·95	£84·10

GOLDRING GL72 T/Table & P.U. **£29·95** (Rec. Price £37·29) Carr. 75p
with Free Goldring G800 Cartridge worth over £10 fitted to above unit.

GOLDRING GL75 T/Table & P.U. **£34·95** (Rec. Price £57·19) Carr. 85p
with Free Goldring G800 Cartridge worth over £10 fitted to above unit.

PIONEER PL12D T/Table on plinth & cover **£39·95** List £55·97

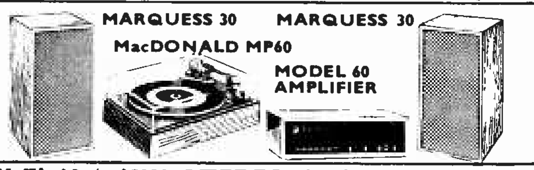
MacDonald MP60 T/Table and P.U. **£9·95** List £14·94

T/TABLES with MAGNETIC CARTRIDGE/PLINTH & COVER

GARRARD SP25 with G850 or G800 **Special Price £19·95** (Carr. £1)

MacDonald MP60 with G800 or G850 ... ... **£18·95** (Carr. £1)

GOLDRING GL75 with G800 **Special price £39·95** (Carr. £1)



A HI-FI-30 + 30W STEREO SYSTEM

AUDIO FIDELITY MODEL 60 AMPLIFIER.
PAIR AUDIO FIDELITY MARQUESS 30 SPKRS.
GARRARD SP25 Mk IV or McDONALD MP60
with G800 Cartridge. Ready wired on Plinth with Cover.
Cabinets finished in Teak Veneer. Send S.A.E. for leaflet.

£99·95 Total Value approx. £165 Carr. £3

HI-FI 10 + 10W STEREO SYSTEM

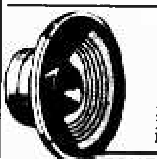
AUDIOTRINE STEREO 20 AMPLIFIER
GARRARD TURNTABLE with Sonotone Cartridge wired-on Plinth with cover.
PAIR DIPLOMAT 10w SPEAKERS, Teak Veneer finish. Carr. £2

SPECIAL PURCHASE Worth Double **£55**

RSC G66 MkII 6+6 WATT high quality STEREO AMPLIFIER

Controls: Bass, Treble, Vol. and Bal. 10 Transistors plus Diodes. Output rating I.H.F.M. Frequency range 20-20,000 c.p.s. Bass Control ± 12db. Treble Control ± 13db. Selector switch for Crystal P.U. or Tape/Radio. For speaker output impedances of 3 — 15 ohms. For standard 200-250v. A.C. mains operation. Attractive Black and Silver finished metal fascia plate and matching control knobs. COMPLETE KIT OF PARTS INCLUDING FULLY WIRED PRINTED CIRCUIT and COMPREHENSIVE WIRING DIAGRAMS & INSTRUCTIONS **£12·75** Carr. 40p
Or FACTORY BUILT IN TEAK VENEERED CABINET as illustrated £16·50 or dep. £2·12 and 8 monthly payments £2·12 (Total £19·08).

AUDIOTRINE HIGH FIDELITY SPEAKERS



Heavy construction. Latest high efficiency ceramic magnets. Plasticised Cone surround, "D" or "T" indicates Tweeter Cone providing extended frequency range up to 15,000 c.p.s. Impedance 3 or 8–15 ohms. PLEASE STATE CHOICE.

Exceptional performance at low cost.

HF808T	8"	10W	£2·55	HF120D	12"	15W	£6·50
HF102D	10"	10W	£3·30	HF126	12"	15W	£7·95
HF120	12"	15W	£5·95	HF126D	12"	15W	£8·50

FANE 807T HIGH FIDELITY SPEAKER

A full range 8in. 10 watt unit for excellent sound quality, in suitable enclosure. Cast chassis Roll P.V.C. cone surround and long throw voice coil to achieve very low fundamental resonance of 30 c.p.s. Tweeter cone is fitted to extend high note response. Frequency range 25 Hz to 15 KHz. Gauss 10,000. Impedance 3 or 8·15 Ω.
PLEASE STATE IMPEDANCE REQUIRED List £4·50 **£3·99**
MODEL 803T 8" 15w. with parasitic Tweeter.
Response 25 Hz to 15 KHz. Gauss 13,000 Imp 3 or 8–15Ω. **£5·50** List £6·50

HI-FI SPEAKER ENCLOSURES

Teak veneer finish. Acoustically lined. Sizes approx. Carr. 45p.per enc.

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SE12 For excellent performance with 12in. Hi-Fi speaker and tweeter 25½ × 16 × 9in. **£7·95**

AUDIOTRINE HI-FI SPEAKER SYSTEMS

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R.S.C. TA6 6 Watt HI-FI AMPLIFIER

200-250v. AC mains operated. Response 30-20,000 c.p.s. −2dB. Separate Bass and Treble 'lift and cut' controls. 3 input sockets for Mike, Gram, Radio or Tape. Input selector switch. Output for 3–15 ohm spkrs. Max. sensitivity 5mV. O/P rating I.H.F.M. Enclosed enamelled case 9½ × 2½ × 5½in. Silver finish facia 10½ × 3½in. Complete kit, wiring diagrams and instructions. **£7·95** Carr. 40p. FACTORY BUILT **£10·95**

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Fully Transistorised. Hi-Fi o/p of 6·5 watts per channel. Optimum performance with any crystal or ceramic P.U. Cartridge, Radio Tuner, Tape Rec. etc. Input Sel. Switch, Bass, Treble, Vol. & Bal. Controls. COMPLETE KIT OF PARTS WITH FULL WIRING DIAGRAMS & INSTRUCTIONS **£12·99** Carr. 40p.
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AUDIO FIDELITY FR1 SPEAKER KIT

Response 30Hz-15KHz. Rating 15 watts in sealed cabinet Imp. 8·15 ohms. 8" Bass Unit with P.V.C. Cone surround for ultra low resonance. Pressure Tweeter. Printed Circuit. Inductive/Capacitive Cross-over. Damping Material. Screws, Terminal Panels.
£11 each. Carr. Free. SPECIAL OFFER **£14·99** Pair Carr. 50p

R.S.C. MkIII SUPER 30 HIGH FIDELITY STEREO AMPLIFIER

BUILD AN AMPLIFIER WORTH APPROXIMATELY DOUBLE THE KIT PRICE INCLUDING CABINET
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- Neon Indicator
- Satin Silver Finish Metal Fascia
- Solid State Circuitry
- Twenty Silicon Transistors
- Four Diodes, Four Rectifiers

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For Magnetic or Ceramic Pick-Ups regardless of Price. Output (per channel) 15 watts RMS into 8Ω. Frequency Response 7 Hz to 70 KHz ± 1½ dB.

COMPLETE KIT (less cabinet). Carr. 70p. Cabinet if req. £5 extra. **£22·95**

R.S.C. STEREO FM III TUNER. in cabinet Visually matches Super 30 Mk. III **£37·95**

FACTORY BUILT UNIT INC. CABINET with 12 months' guarantee. Or Dep. £7 and 8 monthly payments £5·17 (Total £48·36). **£42·50**

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★ Moderate size only 25 × 14 × 10in. approx.
★ Response 30-20,000 c.p.s. Impedance 15 ohms

Performance comparable with units costing considerably more. COMPLETE KIT **£25·95** Carr. 75p
Consists of (1) 12in. 15w Bass unit with cast chassis. Roll rubber cone surround for ultra low resonance. (2) 3-way quarter section series cross-over system. (3) 8 × 5in. high flux middle range speaker. (4) Dome Pressure Tweeter. (5) Quantity acoustic damping material. (6) Handsome Teak veneered cabinet. (7) Circuit and full instructions. Terms. Deposit £4·71 and 8 monthly payments £3·12 (Total £29·67)

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506	£2·61	1005	£3·65	121/15LR	£5·33	138/15LR	£4·83
507	£1·08	1006	£3·50	138/10	£2·18	138/15TLR	£4·96
508	·96	1008	£2·93	138/10T	£2·31	101/10A	£4·27
801	£3·93	1001LR	£5·09	138/10LR	£2·50	101/14	£6·64
802	£3·69	1005LR	£4·37	138/10TLR	£2·63	101/14A	£6·74
802T	£3·82	121/10	£3·17	138/11	£3·55	122/10	£5·16
805	£3·25	121/10T	£3·37	138/11LR	£3·87	122/10A	£5·49
806	£2·56	121/11	£3·58	138/13	£3·83	122/10LR	£6·03
1001	£4·37	121/11T	£3·78	138/13LR	£4·15	122/10T	£5·49

Model No.	Price (inc. VAT)	Model No.	Price (incl. VAT)	Model No.	Price (inc. VAT)
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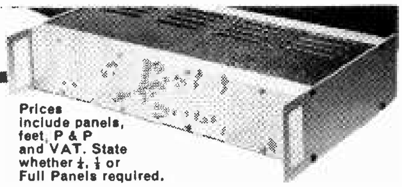
122/12T	£7·08	122/17T	£10·59	152/17	£14·96
122/14	£8·47	122/17LR	£10·98	153	£17·48
122/14A	£8·80	122/17ALR	£11·31		

All Transformers available as previously advertised

'Brightcase' anodised cases



THE WEST HYDE PRESTIGE CASE
The smartest of the West Hyde cases all anodised aluminium, with top and bottom panels only, in black PVC covered steel (plain or louvered). Free standing or 19in. rack mounting with aluminium brackets. Supplied ex stock, fully assembled, with SS Pozi-drive screws.

Prices include panels, feet, P & P and VAT. State whether ¼, ½ or Full Panels required.

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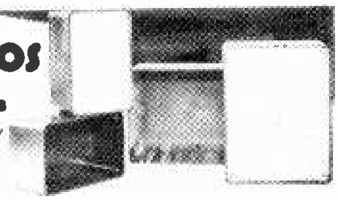
BC21 (3½" whole rack)	£13·46	88p	74p
BC22 (3½" half rack)	£10·90	88p	74p
BC31 (5¼" whole rack)	£15·53	£1·24	74p
BC32 (5¼" half rack)	£12·79	£1·24	74p

Prices correct May 1974

MINOS PLASTIC CASES



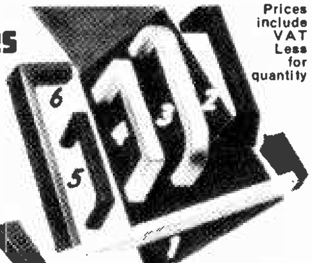
A smart miniature case in tough, rigid, high-gloss black A.B.S. Front panels in either aluminium or white PVC/Steel. Built-in slots for PC cards, dividers, or screens. Chassis or PC boards can be supported on "P" clips from internal pillars. Excellent as encapsulation boxes. Prices include P. & P. and VAT. Less for quantities. Also available less panel and screws. Minimum order £1.

	1 off	10 off
M2 65mm×100mm×50mm 2½"×3¾"×2"	51p	45p
M3 100mm×130mm×50mm 3¾"×5"×2"	67p	58p

Prices correct May 1974

CONTIL handles

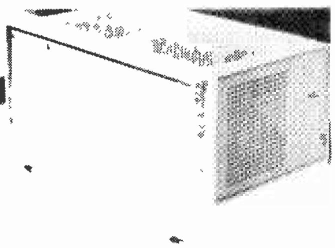
Prices include VAT Less for quantity



(1) No. 265 Anodised aluminium centre bar. Black plastic brackets with moulded-in core. 75mm. 97p. 5 more sizes up to 154mm.
(2) No. 281.1. Nylon 112mm. Load 50kg. 45p.
(3) No. 277. All., ground, polished, anodised. 88mm. 94p. 120mm, £1·06
(4) No. 268. Satin all. 57·5mm. 94p., 102mm, £1·01, 145·5 £1·17.
(5/6) No. 250. Black nylon. Very comfortable. 75mm, 29p, 110mm. 41p. 155mm, 67p.
Prices correct May 1974

P. & P. 22p any quantity. Write or phone for new catalogue

AMTRON VENTILATED METAL CASES

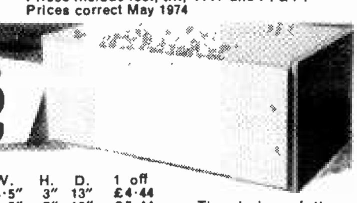


AMTRON METAL CABINETS GIVE EXTRA VENTILATION
Ideal for Stabilised Power Supply Units. A lightweight case with perforated sides and top. The front panel is of heavy gauge anodised all. The top, bottom, sides and back interlock, secured by 4 screws. The front frame is a clever moulding holding the panels allowing for 4 hidden fixings for a chassis if required (not supplied). Integrally moulded front feet also form the mounting for the tilt support which is standard with this matt blue painted case.

Height	Length	Depth	Code	1 off
120mm	284mm	138mm	00 3009-00	£6·40
120mm	224mm	138mm	00 3009-10	£5·61
120mm	284mm	188mm	00 3009-20	£7·07

Less for quantity
Prices include feet, tilt, VAT and P. & P.
Prices correct May 1974

CONTIL MOD-2



	W.	H.	D.	1 off		W.	H.	D.	1 off
A	4·5"	3"	6·5"	£3·60	M	4·5"	3"	13"	£4·44
B	4·5"	7"	6·5"	£4·44	N	4·5"	7"	13"	£5·44
C	4·5"	10"	6·5"	£4·91	O	4·5"	10"	13"	£6·91
D	9"	3"	6·5"	£4·91	P	9"	3"	13"	£5·44
E	9"	7"	6·5"	£5·44	Q	9"	7"	13"	£6·91
F	9"	10"	6·5"	£6·28	R	9"	10"	13"	£8·41
G	13"	3"	6·5"	£5·44	S	13"	3"	13"	£6·91
H	13"	7"	6·5"	£6·28	T	13"	7"	13"	£8·41
I	13"	10"	6·5"	£6·91	U	13"	10"	13"	£10·20
J	18"	3"	6·5"	£6·28	V	18"	3"	13"	£8·41
K	18"	7"	6·5"	£8·41	W	18"	7"	13"	£10·20
L	18"	10"	6·5"	£10·20	X	18"	10"	13"	£12·21

The design of these cases permits the instrument to be built or serviced within their external panels. 48 shapes. Low cost. Blue PVC/Steel with white P.V.C./aluminium panels. Prices correct May 1974.

Woodgrain: D £5·44, E & G £6·28, H £6·91. Prices includes screws, rubber feet, one or two chassis according to size and P. & P. and VAT.

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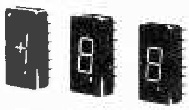

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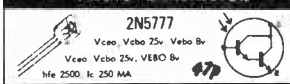

2N5777
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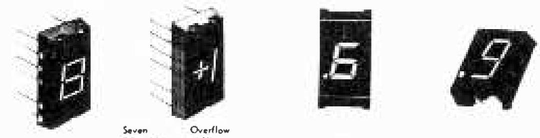

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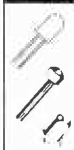

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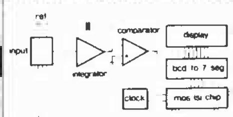

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TRIACS

1·6AMP PLASTIC TO5			6·5AMP ISOLATED TAB			10AMP ISOLATED TAB		
NAS0161W	100V	·27	NAS0651W	100V	·46	NAS1001W	100V	·63
NAS0161X	100V	·26	NAS0651X	100V	·44	NAS1001X	100V	·60
NAS0162W	200V	·30	NAS0652W	200V	·58	NAS1002W	200V	·78
NAS0162X	200V	·28	NAS0652X	200V	·56	NAS1002X	200V	·74
NAS0164W	400V	·40	NAS0654W	400V	·84	NAS1004W	400V	1·09
NAS0164X	400V	·38	NAS0654X	400V	·80	NAS1004X	400V	1·04
NAS0166W	600V	·55	NAS0656W	600V	1·05	NAS1006W	600V	1·34
NAS0166X	600V	·52	NAS0656X	600V	1·00	NAS1006X	600V	1·28

3AMP "CLIPPED TAB"			8·5AMP ISOLATED TAB			16AMP ISOLATED METAL		
NAS0301W	100V	·30	NAS0851W	100V	·52	NAS1601W	100V	·84
NAS0301X	100V	·28	NAS0851X	100V	·50	NAS1601X	100V	·80
NAS0302W	200V	·36	NAS0852W	200V	·67	NAS1602W	200V	·90
NAS0302X	200V	·34	NAS0852X	200V	·64	NAS1602X	200V	·86
NAS0304W	400V	·52	NAS0854W	400V	·97	NAS1604W	400V	1·32
NAS0304X	400V	·50	NAS0854X	400V	·92	NAS1604X	400V	1·26
NAS0306W	600V	·70	NAS0856W	600V	1·20	NAS1606W	600V	1·68
NAS0306X	600V	·66	NAS0856X	600V	1·14	NAS1606X	600V	1·60

Devices with Internal Trigger have "W" suffix. "X" denotes Standard Triac

THYRISTORS

1·6AMP MINI TO5			4AMP ISOLATED TAB			6AMP ISOLATED TAB		
NAS006R	50PIV	·20	NAS106S5	50V	·26	NAS206S5	50V	·29
NAS006S	100PIV	·23	NAS106T5	100V	·30	NAS206T5	100V	·33
NAS006T	200PIV	·25	NAS106U5	200V	·38	NAS206U5	200V	·42
NAS006V	400PIV	·35	NAS106V5	400V	·60	NAS206V5	400V	68
NAS006X	600PIV	·45						

8AMP ISOLATED TAB			16AMP ISOLATED TAB		
NAS306S5	50V	·32	NAS806S5	50V	·45
NAS306T5	100V	·38	NAS806T5	100V	·53
NAS306U5	200V	·47	NAS806U5	200V	·66
NAS306V5	400V	·75	NAS806V5	400V	£1·05

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The unique CT7001 represents a major breakthrough in Clock Chip design, incorporating many features available for the first time:
365 DAY CALENDAR – 12/24 HR. OPERATION – ALARM – SNOOZE ALARM – SIX DIGIT CAPABILITY – DIRECT DRIVE TO LED DISPLAY – CONTINUOUS OPERATION DURING MAINS FAILURES.
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EC88	0·77
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ECC82	0·43
ECC83	0·45
ECC84	0·55
ECC85	0·53
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ECF86	0·71
ECH81	1·00
ECH83	1·00
ECH84	0·78
ECL80	0·53
ECL82	0·61
ECL83	0·68
ECL86	0·63

EF80	0·46
EF83	1·03
EF85	0·43
EF86	0·90
EF89	0·81
EF91	1·30
EF92	1·40
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EF183	0·60
EF184	0·60
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EL34	0·95
EL36	1·05
EL81	0·90
EL84	0·47
EL85	0·55
EL86	0·95
EL95	0·70
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PC97	0·45
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PCC84	0·52
PCC88	0·80
PCC89	0·65
PCC189	0·65
PCF80	0·51
PCF82	1·30
PCF86	0·65
PCF200	0·85
PCF201	0·87
PCF801	0·65
PCF802	0·71
PCF806	0·66
PCH200	0·88
PCL82	0·54
PCL83	0·66
PCL84	0·59
PCL85	0·63
PCL86	0·63
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PFL200	0·80
PL36	0·88
PL81	0·75
PL81A	0·88
PL82	0·50
PL83	0·96

PL84	0·66
PL504	0·88
PL508	1·05
PL509	1·55
PL802	0·96
PY33	0·66
PY81/800	0·50
PY82	0·55
PY88	0·60
PY500A	1·05
PY800	0·50
PY801	0·50
U26	1·00
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UBF89	0·60
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30FL2	0·75
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30FL14	0·85
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DF96	0·50
DK91	0·45
DK92	0·70
DK96	0·60
DL92	0·40
DL94	0·48
DL96	0·55
DY86/7	0·36
DY802	0·37
EABC80	0·38
EAF42	0·75
EB91	0·22
EBC33	1·00
EBC41	0·75
EBC81	0·33
EBF80	0·40
EBF83	0·40
EBF89	0·32
EBL31	1·50
ECC81	0·40
ECC82	0·33
ECC83	0·33
ECC84	0·30
ECC85	0·40
ECC88	0·40
ECH35	1·25
ECH42	1·00
ECH81	0·30
ECH83	0·45
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ECL83	0·70
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EF80	0·25
EF85	0·35
EF86	0·30
EF89	0·28
EF91	0·37
EF92	0·50
EF95	0·40
EF98	0·75
EF183	0·30
EF184	0·35
EL32	0·60
EL33	1·75
EL34	0·50
EL36	0·50
EL37	2·50
EL41	0·90
EL42	0·90
EL84	0·28
EL95	0·40
ELL80	1·00
EM80	0·45
EM81	0·60
EM84	0·35
EM85	1·00
EY51	0·40
EY86	0·40
EZ40	0·75
EZ41	0·75
EZ80	0·28
EZ81	0·29
GY501	0·90
GZ30	0·45
GZ32	0·50
GZ34	0·65
GZ37	1·25
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KT61	1·75
KT66	2·50
KT81 (7C5)	1·30
KT81	1·75
KT88	2·90
KTW61	1·00
MU14	1·00
N78	2·75

PC86	0·60
PC88	0·60
PC97	0·50
PC900	0·48
PCC84	0·40
PCC88	0·55
PCC89	0·50
PCC189	0·60
PCF80	0·30
PCF82	0·35
PCF86	0·60
PCF801	0·50
PCF802	0·50
PCF805	0·90
PCF806	0·75
PCF808	0·90
PCL82	0·35
PCL83	0·66
PCL84	0·45
PCL85	0·50
PCL86	0·45
PCL805/85	0·50
PD500	1·30
PEN45	0·75
PL36	0·55
PL81	0·50
PL82	0·45
PL83	0·45
PL84	0·40
PL500	0·75
PL504	0·75
PL508	0·90
PL509	1·55
PL802	0·95
PX4	3·50
PX25	3·50
PY33	0·63
PY81	0·50
PY82	0·35
PY83	0·38
PY88	0·40
PY500	1·05
PY81/800	0·50
PY801	0·50

8P41	3·00
8P61	0·75
T41	1·00
U14	1·00
U25	0·85
U26	0·85
U191	0·75
UABC80	0·40
UAF42	0·75
UBC41	0·75
UBC81	0·45
UBF80	0·40
UBF89	0·40
UCC85	0·45
UCH42	0·75
UCH81	0·40
UCL82	0·85
UCL83	0·70
UF41	0·75
UF89	0·40
UL41	0·85
UL84	0·48
UY41	0·48
UY85	0·40
VR105-30	0·40
VR150-30	0·40
OA2	0·40
OB2	0·40
1R5	0·45
1S5	0·30
IT4	0·30
3S4	0·40
3V4	0·70
5R4GY	0·80
5U4G	0·40
5V4G	0·50
5Y3GT	0·45
5Z4G	0·45
6/30L2	0·90
6AK5	0·40
6AM5	0·90
6AQ5	0·45
6AS7G	0·85
6AT6	0·45
6AU6	0·30
6BA6	0·28
6BE6	0·35
6BH6	0·75
6BJ6	0·55
6BQ7A	0·55
6BR7	1·00
6BS7	1·35
6BW6	0·90
6BW7	0·90
6C4	0·35
6CD6G	1·30
6CH6	1·40
6CW4	1·00
6F23	1·05
6F25	1·00
6F28	0·70
6J5M	0·65
6J5G	0·45

6J6	0·30
6J7M	0·45
6J7G	0·40
6K6GT	0·75
6K7M	0·45
6K7G	0·30
6K8M	0·70
6K8G	0·45
6K25	0·75
6L6G	0·55
6Q7M	0·50
6Q7G	0·50
6SL7GT	0·48
6SN7GT	0·48
6SQ7GT	0·50
6U5G	0·75
6V6G	0·40
6V6GT	0·45
6X4	0·40
6X5G	0·40
6X5GT	0·45
7B6	0·75
7B7	0·70
7C5	1·30
7C6	0·75
7H7	0·70
7R7	0·75
7S7	2·25
7Y4	0·75
12AT6	0·40
12AT7	0·40
12AU6	0·45
12AU7	0·33
12AX7	0·33
12BA6	0·45
12BE6	0·50
30C1	0·30
30C15	1·05
30C17	1·10
30C18	0·90
30F5	1·10
30FL1	0·80
30FL2	0·75
30FL14	0·90
30L15	1·05
30L17	0·95
30P4MR	1·30
30P12	1·05
30P19	1·00
30PL1	0·95
30PL13	1·20
30PL14	1·25
35W4	0·50
35Z4GT	0·70
50CD6G	1·20
807	0·50
813 ITT	£13
813 USSR	£5·75
866A	1·00

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3p for first Transistor, for each additional add 1p.

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AA119	0·7
AAZ13	0·10
AAZ15	0·10
AC107	0·35
AC126	0·25
AC127	0·25
AC128	0·20
AC176	0·25
AC187	0·20
AC188	0·20
ACY21	0·22
ACY39	0·65
AD140	0·50
AD149	0·50
AD161	0·39
AD162	0·39
AF115	0·25
AF116	0·25
AF117	0·20
AF186	0·40
AF239	0·44
ASY27	0·30
ASY28	0·25
BA102	0·25
BA115	0·10
BC107	0·12
BC108	0·12
BC109	0·12
BC113	0·16
BC117	0·21
BC143	0·30
BC147	0·12
BC148	0·10
BC169C	0·14
BC182	0·12
BC182L	0·12
BC184L	0·13
BCY32	1·20
BCY33	0·38
BCY34	0·45
BCY70	0·15
BCY71	0·20
BCY72	0·15
BCZ11	0·65
BD121	1·00
BD124	0·80
BD131	0·45

BD132	0·50
BF115	0·22
BF167	0·25
BF173	0·28
BF179	0·33
BF180	0·35
BF181	0·35
BF194	0·13
BF195	0·13
BF197	0·15
BF200	0·32
BF861	0·25
BF898	0·25
BFX29	0·28
BFX88	0·22
BFY50	0·20
BFY51	0·20
BFY52	0·20
BFW10	0·61
BY100	0·15
BY126	0·14
BY127	0·15
BZX61 series	0·20
BZY88 series	0·10
CR81-05	0·30
CR81-40	0·45
CR83-05	0·40
CR83-40	0·55
MJE340	0·50
MJE370	0·68
MJE520	0·65
MJE2955	1·10
MJE3055	0·75
MPF102	0·40
MPF103	0·36
MPF104	0·35
MPF105	0·46
NKT404	0·60
OA5	0·60
OA10	0·40
OA79	0·10
OA81	0·10
OA91	0·7
OA200	0·08
OA202	0·10

OC16	1·00
OC20	2·00
OC23	1·25
OC25	0·40
OC28	0·70
OC35	0·55
OC36	0·65
OC42	0·40
OC44	0·18
OC45	0·18
OC71	0·15
OC72	0·25
OC76	0·30
OC77	0·55
OC81	0·28
OC81D	0·28
OC81Z	0·45
OC83	0·25
OC140	0·65
OC170	0·25
OC171	0·30
OC200	0·55
OC201	0·80
OC202	0·90
OC203	0·55
OCP71	1·00
ORP12	0·55
ORP60	0·45
T1005	0·20
TIC44	0·29
TIC226D	1·50
TIL209	0·25
TI843	0·26
ZTX107	0·12
ZTX108	0·10
ZTX300	0·14
ZTX301	0·14
ZTX302	0·20
ZTX304	0·24
ZTX500	0·15

ZTX501	0·15
ZTX503	0·16
ZTX531	0·25
ZTX550	0·18
1N914	0·06
IN4001	0·6
IN4002	0·7
IN4003	0·8
IN4004	0·8
IN4005	0·10
IN4006	0·12
IN4007	0·12
1N4009	0·06
1N4148	0·06
1S921	0·07
1S2033	0·20
1S2051A	0·10
1S2100A	0·20
1S3010	0·25
2N696	0·15
2N697	0·15
2N706	0·10
2N706A	0·12
2N1131	0·25
2N1132	0·25
2N1302	0·18
2N1303	0·18
2N1304	0·22
2N1305	0·22
2N1306	0·28
2N1307	0·28
2N1308	0·28
2N1309	0·30
2N1613	0·20
2N1614	0·45
2N2147	0·75
2N2160	1·00
2N2369A	0·16
2N2646	0·50

2N2904	0·20
2N2904A	0·25
2N2905	0·32
2N2905A	0·25
2N2906	0·20
2N2926	0·10
2N3053	0·20
2N3055	0·60
2N3525	0·80
2N3614	0·59
2N3615	0·65
2N3702	0·11
2N3703	0·12
2N3704	0·14
2N3705	0·12
2N3706	0·10
2N3707	0·13
2N3708	0·07
2N3709	0·10
2N3710	0·11
2N3711	0·11
2N3819	0·35
2N3820	0·50
2N3823	0·50
2N3903	0·15
2N3904	0·20
2N3905	0·25
2N3906	0·16
2N4058	0·15
2N4059	0·10
2N4060	0·13
2N4061	0·18
2N4062	0·14
2N4289	0·20
3N141	0·81
40360	0·40
40361	0·45
40362	0·40
40430	0·85

SN7400	0·26
SN7401	0·20
SN7402	0·20
SN7403	0·20
SN7404	0·20
SN7405	0·20
SN7406	0·40
SN7407	0·40
SN7408	0·25
SN7409	0·33
SN7410	0·20
SN7411	0·28
SN7412	0·28
SN7413	0·30
SN7416	0·30
SN7417	0·30
SN7420	0·20
SN7422	0·28
SN7423	0·40

SN7425	0·37
SN7427	0·37
SN7428	0·43
SN7430	0·20
SN7432	0·37
SN7433	0·43
SN7437	0·43
SN7438	0·43
SN7440	0·20
SN7441AN	0·85
SN7442	0·85
SN7450	0·20
SN7451	0·20
SN7453	0·20
SN7454	0·20
SN7460	0·20
SN7470	0·33
SN7472	0·38

SN7473	0·44
SN7474	0·48
SN7475	0·59
SN7476	0·45
SN7480	0·80
SN7482	0·87
SN7483	1·20
SN7484	1·00
SN7486	0·50
SN7490	0·75
SN7491AN	1·10
SN7492	0·75
SN7493	0·75
SN7494	0·85
SN7495	0·85
SN7496	1·00
SN7497	4·32
SN74100	2·16

SN74107	0·51
SN74110	0·57
SN74111	0·86
SN74118	1·00
SN74119	1·92
SN74121	0·57
SN74122	0·80
SN74123	1·44
SN74141	1·00
SN74145	1·44
SN74150	2·30
SN74151	1·15
SN74154	2·30
SN74155	1·15
SN74156	1·15

SN74157	1·09
SN74170	2·88
SN74174	1·80
SN74175	1·29
SN74176	1·44
SN74190	2·30
SN74191	2·30
SN74192	2·30
SN74193	2·30
SN74194	1·72
SN74195	1·44
SN74196	1·58
SN74197	1·58
SN74198	3·16
SN74199	2·88

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AC107	22	AD161 and		BC150	20	BD131	55	BF182	44	MAT121	22	2G308	39	2N2192	39	2N3391A	18	2N4062	13
AC113	20	AD162(MP)	75	BC151	22	BD132	66	BF183	44	MJE2955	95	2G309	39	2N2193	39	2N3392	16	2N4284	19
AC115	22	ADT140	55	BC152	19	BD133	72	BF184	28	MJE3055	62	2G339	22	2N2194	39	2N3393	16	2N4285	19
AC117K	32	AF114	27	BC153	31	BD135	44	BF185	33	MJE3440	55	2G339A	18	2N2217	24	2N3394	16	2N4286	19
AC122	13	AF115	27	BC154	33	BD136	44	BF187	30	MPF102	46	2G344	20	2N2218	22	2N3395	19	2N4287	19
AC125	19	AF116	27	BC157	20	BD137	50	BF188	44	MPF104	41	2G345	18	2N2219	22	2N3402	23	2N4288	19
AC126	19	AF117	27	BC158	13	BD138	55	BF194	13	MPF105	41	2G371	18	2N2220	24	2N3403	23	2N4289	19
AC127	20	AF118	39	BC159	13	BD139	61	BF195	13	OC19	39	2G371B	13	2N2221	22	2N3404	31	2N4290	19
AC128	20	AF124	33	BC160	50	BD140	66	BF196	16	OC20	70	2G373	19	2N2222	22	2N3405	46	2N4291	19
AC132	16	AF125	33	BC161	55	BD155	88	BF197	16	OC22	52	2G374	19	2N2368	19	2N3414	17	2N4292	19
AC134	16	AF126	31	BC167	13	BD175	66	BF200	50	OC23	54	2G377	33	2N2369	16	2N3415	17	2N4293	19
AC137	16	AF127	31	BC168	13	BD176	66	BF222	£1·05	OC24	62	2G378	18	2N2369A	16	2N3416	31	2N5172	13
AC141	20	AF139	33	BC169	13	BD177	72	BF257	50	OC25	42	2G381	18	2N2411	27	2N3417	31	2N5294	60
AC141K	32	AF178	55	BC170	13	BD178	72	BF258	66	OC26	32	2G382	18	2N2412	27	2N3525	83	2N5457	35
AC142	20	AF179	55	BC171	16	BD179	77	BF259	94	OC28	55	2G401	33	2N2646	52	2N3614	74	2N5458	35
AC142K	28	AF180	55	BC172	16	BD180	77	BF262	61	OC29	55	2G414	33	2N2711	23	2N3615	82	2N5459	44
AC151	17	AF181	55	BC173	16	BD185	72	BF263	61	OC35	46	2G417	28	2N2712	23	2N3616	82	2N6211	75
AC154	22	AF186	55	BC174	16	BD186	72	BF270	39	OC36	55	2N388	39	2N2714	23	2N3646	10	2S301	55
AC155	22	AF239	41	BC175	24	BD187	77	BF271	33	OC41	22	2N388A	61	2N2904	19	2N3702	13	2S302A	46
AC156	22	AL102	72	BC177	21	BD188	77	BF272	88	OC42	27	2N404	22	2N2904A	23	2N3703	13	2S302	46
AC157	27	AL103	72	BC178	21	BD189	83	BF273	39	OC44	17	2N404A	31	2N2905	23	2N3704	14	2S303	61
AC165	22	ASY26	28	BC179	21	BD190	83	BF274	39	OC45	14	2N524	46	2N2905A	23	2N3705	13	2S304	77
AC166	22	ASY27	33	BC180	27	BD195	94	BFW10	66	OC70	11	2N527	54	2N2906	17	2N3706	13	2S305	86
AC167	22	ASY28	28	BC181	27	BD196	94	BFX29	30	OC71	11	2N598	46	2N2906A	20	2N3707	14	2S306	86
AC168	27	ASY29	28	BC182	11	BD197	99	BFX84	24	OC72	16	2N599	50	2N2907	22	2N3708	09	2S307	86
AC169	16	ASY50	28	BC182L	11	BD198	99	BFX85	33	OC74	16	2N696	14	2N2907A	24	2N3709	10	2S321	62
AC176	22	ASY51	28	BC183	11	BD199	£1·05	BFX86	24	OC75	17	2N697	15	2N2923	16	2N3710	10	2S322	46
AC177	27	ASY52	28	BC183L	11	BD200	£1·05	BFX87	27	OC76	17	2N698	27	2N2924	16	2N3711	10	2S322A	46
AC178	31	ASY54	28	BC184	13	BD205	88	BFX88	24	OC77	28	2N699	39	2N2925	16	2N3819	31	2S323	62
AC179	31	ASY55	28	BC184L	13	BD206	88	BFY50	22	OC81	17	2N706	09	2N2926(G)	14	2N3820	55	2S324	77
AC180	22	ASY56	28	BC186	31	BD207	£1·05	BFY51	22	OC81D	17	2N706A	10	2N2926(Y)	12	2N3821	39	2S325	77
AC180K	32	ASY57	28	BC187	31	BD208	£1·05	BFY52	22	OC82	17	2N708	13	2N2926(O)	11	2N3823	31	2S326	77
AC181	22	ASY58	28	BC207	12	BDY20	£1·10	BFY53	19	OC82D	17	2N711	33	2N2926(R)	11	2N3903	31	2S327	77
AC181K	32	ASY73	28	BC208	12	BF115	27	BPX25	94	OC83	22	2N717	39	2N2926(B)	11	2N3904	33	2S701	46
AC187	24	ASZ21	44	BC209	13	BF117	50	BSX19	17	OC139	22	2N718	27	2N3010	77	2N3905	31	40361	44
AC187K	25	BC107	12	BC212L	12	BF118	77	BSX20	17	OC140	22	2N718A	55	2N3011	16	2N3906	30	40362	50
AC188	24	BC108	12	BC213L	12	BF119	77	BSY25	17	OC169	28	2N726	31	2N3053	19	2N4058	13		
AC188K	25	BC109	13	BC214L	16	BF121	50	BSY26	17	OC170	28	2N727	31	2N3054	51	2N4059	11		
ACY17	28	BC113	11	BC225	28	BF123	55	BSY27	17	OC171	28	2N743	22	2N3055	55	2N4060	13		
ACY18	22	BC114	17	BC226	39	BF125	50	BSY28	17	OC200	28	2N744	22	2N3391	16	2N4061	13		
ACY19	22	BC115	17	BC301	30	BF127	55	BSY29	17	OC201	31	2N914	16						
ACY20	22	BC116	17	BC302	27	BF152	61	BSY38	20	OC202	31	2N918	33						
ACY21	22	BC117	20	BC303	35	BF153	50	BSY39	20	OC203	28	2N929	23						
ACY22	18	BC118	11	BC304	40	BF154	50	BSY40	31	OC204	28	2N930	23						
ACY27	20	BC119	33	BC440	34	BF155	77	BSY41	31	OC205	39	2N1131	22						
ACY28	21	BC120	88	BC460	40	BF156	53	BSY95	14	OC309	44	2N1132	24						
ACY29	39	BC125	13	BCY30	27	BF157	61	BSY95A	14	OCP71	48	2N1302	16						
ACY30	31	BC126	20	BCY31	29	BF158	61	Bu105	£2·20	ORP12	48	2N1303	16						
ACY31	31	BC132	13	BCY32	33	BF159	66	C111E	55	P20	55	2N1304	19						
ACT34	23	BC134	20	BCY33	24	BF160	44	C400	33	P21	50	2N1305	19						
ACY35	23	BC135	13	BCY34	28	BF162	44	C407	28	P346A	22	2N1306	23						
ACY36	31	BC136	17	BCY70	16	BF163	44	C424	28	P397	46	2N1307	23						
ACY40	19	BC137	17	BCY71	22	BF164	44	C425	55	ST140	14	2N1308	26						
ACY41	20	BC139	44	BCY72	16	BF165	44	C426	39	ST141	19	2N1309	26						
ACY44	39	BC140	33	BCZ10	22	BF167	24	C428	22	TIS43	33	2N1613	22						
AD130	42	BC141	33	BCZ11	28	BF173	24	C441	33	UT46	30	2N1711	22						
AD140	53	BC142	33	BCZ12	28	BF176	39	C442	33	ZN414	£1·20	2N1889	35						
AD142	53	BC143	33	BD115	68	BF177	39	C444	39	2G301	21	2N1890	50						
AD143	42	BC145	50	BD116	88	BF178	33	C450	24	2G302	21	2N1893	41						
AD149	55	BC147	11	BD121	66	BF179	33	MAT100	21	2G303	21	2N2147	79						
AD161	39	BC148	11	BD123	72	BF180	33	MAT101	22	2G304	27	2N2148	63						
AD162	39	BC149	13	BD124	76	BF181	33	MAT120	21	2G306	44	2N2160	66						

DIODES AND RECTIFIERS

AA119	9	BY133	23	OA70	8
AA120	9	BY164	55	OA79	8
AA129	9	BYX38/30	46	OA81	8
AAY30	10	BYZ10	39	OA85	10
AAZ13	11	BYZ11	33	OA90	7
BA100	11	BYZ12	33	OA91	7
BA116	23	BYZ13	28	OA95	8
BA126	24	BYZ16	44	OA200	7
BA148	16	BYZ17	39	OA202	8
BA154	13	BYZ18	39	SD10	6
BA155	16	BYZ19	31	SD19	6
BA156	15	CG62		1N34	8
BY100	17	(OA91 Eq.)	6	1N34A	8
BY101	13	CG651		1N914	7
BY105	19	(OA70-OA79		1N916	7
BY114	13	Eq.)	7	1N4148	7
BY126	16	OA5	39	18021	11
BY127	17	OA58L	23	18951	7
BY128	17	OA10	39		
BY130	18	OA47	8		

LINEAR I.C's—FULL SPEC.

Type No.	Price 1	25	100+
72702	50p	48p	45p
72709	35p	33p	30p
72710	45p	43p	40p
72741	40p	38p	35p
72741C	45p	43p	40p
72741P	38p	36p	34p
72748P	38p	36p	34p
SL201C	59p	45p	40p
SL701C	50p	45p	40p
SL702C	50p	45p	40p
TAA263	80p	70p	60p
TAA293	£1·00	95p	90p
TAA350A	£1·85	£1·80	£1·70
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µA711	45p	43p	40p

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3015F Minitron . . . . £1·50
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ZN414 . . . . . . £1·20 each
I.C. Radio Rec. incl. full cir. data.

DTL 930 SERIES LOGIC I.C's

Type	Price 1	25	100
BP930	15p	14p	13p
BP932	16p	15p	14p
BP933	16p	15p	14p
BP935	16p	15p	14p
BP936	16p	15p	14p
BP944	16p	15p	14p
BP945	30p	28p	25p
BP946	15p	14p	13p
BP948	30p	28p	25p
BP951	70p	65p	60p
BP962	15p	14p	13p
BP9093	45p	43p	40p
BP9094	45p	43p	40p
BP9097	45p	43p	40p
BP9099	45p	43p	40p

Devices may be mixed to qualify for quantity price. Larger quantity prices on application. (DTL 930 Series only).

VOLTAGE REGULATORS

TO.3 Plastic 1·5 Amps
UA.7805. 5v. (Equiv. to MVR 5V) £1·76
UA.7812. 12v. . . . MVR 12V) £1·76

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	Price each 1–24	25–99	100 up
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TSO 16 ,, ,,	38p	35p	32p
LOW COST No.			
BPS 14	16p	14p	12p
BPS 16	17p	15p	13p

ALL PRICES INCLUDE VAT.

74 Series T.T.L. I.C's

BI-PAK STILL LOWEST IN PRICE. FULL SPECIFICATION GUARANTEED. ALL FAMOUS MANUFACTURERS

Type	Quantities 1	25	100+	Type	Quantities 1	25	100+	Type	Quantities 1	25	100
	£ p	£ p	£ p		£ p	£ p	£ p		£ p	£ p	£ p
7400	0·18	0·17	0·16	7448	1·10	1·07	1·05	74122	1·50	1·45	1·40
7401	0·18	0·17	0·16	7450	0·18	0·17	0·16	74123	3·00	2·90	2·80
7402	0·18	0·17	0·16	7451	0·18	0·17	0·16	74141	0·85	0·82	0·79
7403	0·18	0·17	0·16	7453	0·18	0·17	0·16	74145	1·65	1·55	1·45
7404	0·18	0·17	0·16	7454	0·18	0·17	0·16	74150	2·90	2·80	2·70
7405	0·18	0·17	0·16	7460	0·18	0·17	0·16	74151	1·10	1·05	1·00
7406	0·39	0·34	0·31	7470	0·32	0·29	0·27	74153	1·30	1·20	1·10
7407	0·39	0·34	0·31	7472	0·32	0·29	0·27	74154	1·98	1·90	1·75
7408	0·20	0·19	0·18	7473	0·41	0·39	0·35	74155	1·50	1·45	1·35
7409	0·20	0·19	0·18	7474	0·41	0·39	0·35	74156	1·50	1·45	1·35
7410	0·18	0·17	0·16	7475	0·50	0·48	0·46	74157	2·00	1·90	1·80
7411	0·28	0·27	0·26	7476	0·44	0·43	0·42	74160	2·10	2·00	1·90
7412	0·39	0·34	0·31	7480	0·74	0·71	0·64	74161	2·10	2·00	1·90
7413	0·32	0·31	0·30	7481	1·30	1·25	1·20	74162	4·40	4·15	3·85
7416	0·48	0·44	0·42	7482	0·96	0·95	0·94	74163	4·40	4·15	3·85
7417	0·48	0·44	0·42	7483	1·20	1·15	1·05	74164	2·20	2·10	2·00
7420	0·18	0·17	0·16	7484	1·10	1·05	1·00	74165	2·20	2·10	2·00
7422	0·55	0·53	0·50	7485	3·50	3·30	3·30	74166	3·20	3·10	3·00
7423	0·55	0·53	0·50	7486	0·35	0·34	0·33	74174	2·50	2·40	2·30
7425	0·55	0·53	0·50	7489	4·00	3·75	3·50	74175	1·75	1·65	1·55
7426	0·50	0·46	0·44	7490	0·74	0·71	0·64	74176	1·85	1·75	1·65
7427	0·50	0·46	0·44	7491	1·10	1·05	1·00	74177	1·85	1·75	1·65
7428	0·55	0·53	0·50	7492	0·74	0·71	0·64	74180	1·50	1·40	1·30
7430	0·18	0·17	0·16	7493	0·74	0·71	0·64	74181	5·00	4·50	4·00
7432	0·50	0·46	0·44	7494	0·85	0·82	0·75	74182	2·00	1·90	1·75
7433	0·75	0·73	0·70	7495	0·85	0·82	0·75	74184	3·20	3·10	3·00
7437	0·70	0·68	0·65	7496	0·96	0·93	0·86	74190	2·15	2·10	2·00
7438	0·70	0·68	0·65	74100	1·50	1·45	1·40	74191	2·15	2·10	2·00
7440	0·18	0·17	0·16	74104	1·07	1·04	1·00	74192	2·15	2·10	2·00
7441	0·74	0·71	0·64	74105	1·07	1·04	1·00	74193	2·15	2·10	2·00
7442	0·74	0·71	0·64	74107	0·44	0·42	0·40	74194	2·98	2·86	2·75
7443	1·20	1·15	1·10	74110	0·60	0·55	0·50	74195	2·00	1·95	1·90
7444	1·20	1·15	1·10	74111	1·38	1·27	1·21	74196	1·95	1·90	1·85
7445	1·98	1·95	1·90	74118	1·10	1·05	1·00	74197	1·95	1·90	1·85
7446	1·20	1·15	1·10	74119	1·50	1·40	1·30	74198	5·00	4·75	4·50
7447	1·10	1·07	1·05	74121	0·50	0·48	0·45	74199	5·00	4·75	4·50

Devices may be mixed to qualify for quantity price. (TTL 74 series only) data is available for the above series of I.C.'s in booklet form. Price 13p.

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Code No's. mentioned above are given as a guide to the type of device in the pak. The devices themselves are normally unmarked.

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PIV	1A TO5	3A TO66	5A TO66	5A TO64	7A TO48	10A TO48	16A TO48	30A TO48
50	0·26	0·28	0·39	0·39	0·52	0·55	0·59	1·27
100	0·28	0·37	0·52	0·52	0·55	0·64	0·70	1·54
200	0·39	0·41	0·54	0·54	0·63	0·67	0·83	1·76
400	0·48	0·52	0·62	0·62	0·74	0·83	1·03	1·93
600	0·59	0·63	0·75	0·75	0·85	1·07	1·38	—
800	0·70	0·77	0·88	0·88	0·99	1·32	1·65	4·40

SIL. RECTS. TESTED

PIV	300mA	750mA	1A	1·5A	3A	10A	30A
50	0·04	0·06	0·06	0·08	0·16	0·23	0·66
100	0·04	0·07	0·06	0·15	0·18	0·26	0·83
200	0·06	0·10	0·07	0·16	0·22	0·27	1·10
400	0·07	0·15	0·08	0·22	0·30	0·41	1·38
600	0·08	0·18	0·11	0·26	0·38	0·50	2·05
800	0·11	0·19	0·12	0·28	0·41	0·61	2·20
1000	0·12	0·28	0·16	0·33	0·51	0·70	2·75
1200	—	0·37	—	0·42	0·63	0·83	—

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2N3821	30p	BFW10	66p
2N3823	31p	MPF105	41p

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Pak No.	Contents	Price	Pak No.	Contents	Price	Pak No.	Contents	Price
UIC00	= 12 × 7400	0·55	UIC46	= 5 × 7446	0·55	UIC90	= 5 × 7490	0·55
UIC01	= 12 × 7401	0·55	UIC48	= 5 × 7448	0·55	UIC91	= 5 × 7491	0·55
UIC02	= 12 × 7402	0·55	UIC50	= 12 × 7450	0·55	UIC92	= 5 × 7492	0·55
UIC03	= 12 × 7403	0·55	UIC51	= 12 × 7451	0·55	UIC93	= 5 × 7493	0·55
UIC04	= 12 × 7404	0·55	UIC53	= 12 × 7453	0·55	UIC94	= 5 × 7494	0·55
UIC05	= 12 × 7405	0·55	UIC54	= 12 × 7454	0·55	UIC95	= 5 × 7495	0·55
UIC06	= 8 × 7406	0·55	UIC60	= 12 × 7460	0·55	UIC96	= 5 × 7496	0·55
UIC07	= 8 × 7407	0·55	UIC70	= 8 × 7470	0·55	UIC100	= 5 × 74100	0·55
UIC10	= 12 × 7410	0·55	UIC72	= 8 × 7472	0·55	UIC121	= 5 × 74121	0·55
UIC20	= 12 × 7420	0·55	UIC73	= 8 × 7473	0·55	UIC141	= 5 × 74141	0·55
UIC30	= 12 × 7430	0·55	UIC74	= 8 × 7474	0·55	UIC151	= 5 × 74151	0·55
UIC40	= 12 × 7440	0·55	UIC76	= 8 × 7476	0·55	UIC154	= 5 × 74154	0·55
UIC41	= 5 × 7441	0·55	UIC80	= 5 × 7480	0·55	UIC193	= 5 × 74193	0·55
UIC42	= 5 × 7442	0·55	UIC81	= 5 × 7481	0·55	UIC199	= 5 × 74199	0·55
UIC43	= 5 × 7443	0·55	UIC82	= 5 × 7482	0·55			
UIC44	= 5 × 7444	0·55	UIC83	= 5 × 7483	0·55	UICXI	= 25 Assorted	
UIC45	= 5 × 7445	0·55	UIC86	= 5 × 7486	0·55		74's	£1·65

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2 Amp. BRIDGE RECTS.

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100 v RMS	40p ..
400 v RMS	50p ..

Size 16 mm × 16 mm.

D1699 NPN SILICON DUAL TRANSISTOR

(Similar to 2N2060)

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0·28	0·26	0·23

B1P 19/20 TO3 NPN PLASTIC SILICON

Vebo = 100V. Vceo = 50V. I.C. = 10 amps. Ptot 50W. hfe = typ. 100 fT = 3MHz.

			B1P 19/20 Matched Pair		
1	25	100+	1	25	100
0·38	0·35	0·32	0·66	0·61	0·55

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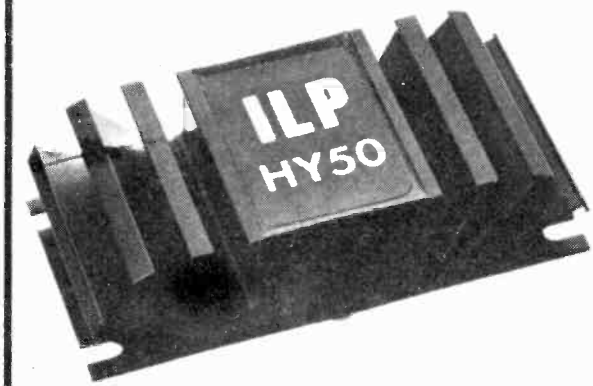


A brand new hybrid fabrication technique, recently perfected in our laboratories, has enabled us to achieve our latest range of completely integrated devices.
We have now finally reduced the modular amplifier to a simple input/output device requiring only the addition of a basic unstabilized (split line) power supply.
The HY50 takes medium power modules to their logical conclusion by incorporating with it a heatsink, which is designed in special high conductivity alloy, sufficient for normal audio use without additional chassis sinking. All this without significantly increasing the size of the module comparable in size to a packet of 'King-size' cigarettes.

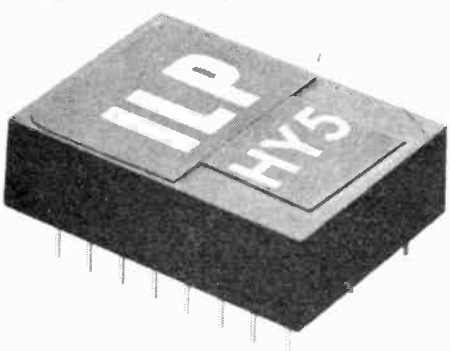
Consistent with modern thinking a triple rated output circuit with a load fuse allows for peak transient response without distortion but ensures the necessary protection.

	SPEC.
OUTPUT POWER:	25 watts RMS. 50 watts peak music power
LOAD IMPEDANCE:	4·16Ω into 8Ω
INPUT SENSITIVITY:	Odb (0·775 volts RMS)
INPUT IMPEDANCE:	47KΩ
TOTAL HARMONIC DISTORTION:	Less than 0·1% at 25 watts typically 0·05
SIGNAL/NOISE RATIO:	better than 75db
FREQUENCY RESPONSE:	10Hz-50KHz ± 1db
SUPPLY VOLTAGE:	± 25 volts
SIZE:	105 x 50 x 25 mm

Price £5·80 mono, £11·60 stereo

Price inclusive of VAT & P & P

NEW HY5 PRE-AMPLIFIER



Unchallenged for two tears, the HY5, our unique multifunction preamplifier/tone hybrid, has been brought into line with the advancements in our power hybrids.
Like the HY50, the new HY5 has no external components & has been redesigned to run off a split power-line with improvements in signal/noise, overload, capability & reduced distortion. The output has been increased to match the power module (Odb), and to share the same power supply.
Overall size is reduced by the use of a new thin film circuitry while the device still retains all the functions of the earlier device.
When combined with the HY50 & power supply only potentiometers are required to complete a simple mono amplifier with input & output facilities expected to be found on Hi-Fi amplifiers.
The combination of two HY5's two HY50's sharing a common power supply (PSU50) are linked by a balance control to form a complete stereo system.

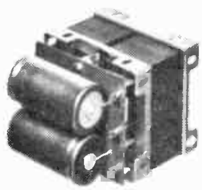
SPEC.

INPUTS
Magnetic Pick-up 3mV (within 1db RIAA curve)
Ceramic Pick-up up to 3mV
Microphone 10mV
Tuner 250mV
Auxiliary 3–100mV
Input impedance 47kΩ 1kHz

OUTPUTS
Tape 100mV.
Main output, Odb (0·775volts)

ACTIVE TONE CONTROLS
Treble ± 12db at 10kHz
Bass ± 12db at 100Hz
OVERLOAD CAPABILITY (equalization stage) 40db on most sensitive input
OUTPUT NOISE LEVEL (below 10mV magnetic input) 68db
DISTORTION 0·05% at 1kHz
SUPPLY VOLTAGE ± 16-25 volts
SUPPLY CURRENT 15mA
Price £4·85 mono, £9·70 stereo
Price inclusive of VAT & P & P

POWER SUPPLY PSU50



The new PSU50 has a low profile look being only 2½ inches high and can be used for either mono or stereo systems.

SPEC.
OUTPUT VOLTAGE ± 25 volts
INPUT VOLTAGE 210-240 volts
SIZE L. 70, D. 90, H. 60 mm

Price £5·23
Price inclusive of VAT & P & P

CROSSLAND HOUSE · NACKINGTON · CANTERBURY · KENT

CANTERBURY 63218

Please note we reserve the right to substitute at our discretion updated versions of advertised designs where applicable.

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DEPT PW, ELSTOW STORAGE DEPOT
KEMPSTON HARDWICK
BEDFORD

C.W.O. PLEASE. POST AND PACKING PLEASE ADD 10p TO ORDERS UNDER £2.

Catalogue which contains data sheets for most of the components listed will be sent free on request. 10p stamp appreciated.

Callers Welcome Mon. to Sat. 9 a.m.–5 p.m.

PLEASE ADD 10% VAT

RESISTORS
½W Iskra high stability carbon film—very low noise—capless construction.
⅓W Mullard CR25 carbon film—very small body size 7·5 x 2·5 mm.
½W 2% ELECTROSIL TR5.

Power watts	Tolerance	Range	Values available	Price 1–99	Price 100+
½	5%	4·7Ω–2·2MΩ	E24	1·3p	1·1p
½	10%	3·3MΩ–10MΩ	E12	1·3p	1·1p
½	2%	10Ω–1MΩ	E24	3·5p	3p
⅓	10%	1Ω–3·9Ω	E12	1·3p	1·1p
⅓	5%	4·7Ω–1MΩ	E12	1·3p	1·1p
4	10%	1Ω–10Ω	E12	8p	7p

Quantity price applies for any selection. Ignore fractions on total order.

DEVELOPMENT PACK
0·5 watt 5% Iskra resistors 5 off each value 4·7Ω to 1MΩ.
E12 pack 325 resistors **£2·40**. E24 pack 650 resistors **£4·70**.

POTENTIOMETERS
Carbon track 5kΩ to 2MΩ, log or linear (log ½ W, lin ⅓W).
Single, **14p**. Dual gang (stereo), **49p**. Single D.P. switch, **25p**.

SKELETON PRESET POTENTIOMETERS
Linear: 100, 250, 500Ω and decades to 5MΩ. Horizontal or vertical P.C. mounting (0·1 matrix).
Sub-miniature 0·1W, 5p each. Miniature 0·25W, 7p each.

SMOKE AND COMBUSTIBLE GAS DETECTOR—GDI
The GDI is the world's first semiconductor that can convert a concentration of gas or smoke into an electrical signal. The sensor decreases its electrical resistance when it absorbs deoxidizing or combustible gases such as hydrogen, carbon monoxide, methane, propane, alcohol, North Sea gas, as well as carbon-dust containing air or smoke. This decrease is usually large enough to be utilized without amplification. Full details and circuits are supplied with each detector. Detector GDI **£2**. Kit of parts for mains operated detector, including GDI but excluding case. **£5·60**. Suitable case **£1·50**. Kit of parts for 12 or 24V battery operation, including GDI and P.C. Board, **£7·70**. As above for PP9 battery, **£6.90**.
NOTE: The battery operated kits incorporate our patented circuit to minimise battery drain. Typically 90mA for 24V.

PRINTED BOARD MARKER **97p**
Draw the planned circuit onto a copper laminate board with the P.C. Pen, allow to dry, and immerse the board in the etchant. On removal the circuit remains in high relief.

MULLARD POLYESTER CAPACITORS C296 SERIES
400V: 0·001μF, 0·0015μF, 0·0022μF, 0·0033μF, 0·0047μF, **3p**. 0·0068μF, 0·01μF, 0·015μF, 0·022μF, 0·033μF, **3½p**. 0·047μF, 0·068μF, 0·1μF, **5p**. 0·15μF, **6p**. 0·22μF, **7½p**. 0·33μF, **11p**. 0·47μF, **13p**.
160V: 0·01μF, 0·015μF, 0·022μF, 0·033μF, 0·047μF, 0·068μF, **3p**. 0·1μF, **3½p**. 0·15μF, **4½p**. 0·22μF, **5p**. 0·33μF, **6p**. 0·47μF, **7½p**. 0·68μF, **11p**. 1·0μF, **13p**.

MULLARD POLYESTER CAPACITORS C280 SERIES
250V P.C. mounting: 0·01μF, 0μ015μF, 0·022μF, **3p**. 0·033μF, 0·047μF, 0·068μF, **3½p**. 0·1μF, **4p**. 0·15μF, 0·22μF, **5p**. 0·33μF, **6½p**. 0·47μF, **8½p**. 0·68μF, **11p**. 1·0μF, **13p**. 1·5μF, **20p**. 2·2μF, **24p**.

MYLAR FILM CAPACITORS 100V
0·001μF, 0·002μF, 0·005μF, 0·01μF, 0·02μF, **3p**. 0·04μF, 0·05μF, 0·068μF, 0·1μF, **4p**.

CERAMIC DISC CAPACITORS
100pF to 10,000pF, **2p** each.

ELECTROLYTIC CAPACITORS
(μF/v) 1/63, 1·5/63, 2·2/63, 3·3/63, 4·7/63, 6·8/40, 6·8/63, 10/25, 10/63, 15/16, 15/40, 15/63, 22/10, 22/25, 22/63, 33/6·3, 33/16, 33/40, 47/4, 47/10, 47/25, 47/40, 68/6·3, 68/16, 100/4, 100/10, 100/25, 150/6·3, 150/16, 220/4, 220/6·3, 220/16, 330/4, **6p**. 47/63, 100/40, 150/25, 220/25, 330/10, 470/6·3, **7p**. 68/63, 150/40, 220/40, 330/16, 1000/4, **10p**. 470/10, 680/6·3, **11p**. 100/63, 150/63, 220/63, 1000/10, **12p**. 470,25, 680/16, 1500/6·3, **13p**. 470/40, 680/25, 1000/16, 1500/10, 2200/6·3, **18p**. 330/63, 680/40, 1000/25, 1500/16, 2200/10, 3300/6·3, 4700/4, **21p**.

SOLID TANTALUM BEAD CAPACITORS **12p**

0·1μF 35V	2·2μF 35V	22μF 16V
0·22μF 35V	4·7μF 35V	33μF 10V
0·47μF 35V	6·8μF 25V	47μF 6·3V
1·0μF 35V	10μF 25V	100μF 3V

VEROBOARD

	0·1	0·15
2½ x 3¾	**24p**	**20p**
2½ x 5	**28p**	**28p**
3¾ x 3¾	**28p**	**28p**
3¾ x 5	**32p**	**32p**
17 x 2½	**85p**	**67p**
17 x 3¾	**120p**	**108p**
17 x 3¾ (plain)	**76p**	**52p**
17 x 2½ (plain)	—	**41p**
2½ x 5 (plain)	—	**12p**
2½ x 3¾ (plain)	—	**11p**
Pin insertion tool	**62p**	**62p**
Spot face cutter	**52p**	**52p**
Pkt. 50 pins	**20p**	**20p**

JACK PLUGS AND SOCKETS

Standard screened	**28p**	2·5mm insulated	**12p**
Standard insulated	**18p**	3·5mm insulated	**12p**
Stereo screened	**40p**	3·5mm screened	**18p**
Standard socket	**20p**	2·5mm socket	**11p**
Stereo socket	**30p**	3·5mm socket	**11p**

D.I.N. PLUGS AND SOCKETS
2 pin, 3 pin, 5 pin 180, 5 pin 240, 6 pin, 7 pin.
Plug 12p. Socket 8p.
4 way screened cable, **25p**/metre.
6 way screened cable, **30p**/metre.

BATTERY ELIMINATOR **£1·70**
9V mains power supply. Same size as PP9 battery.

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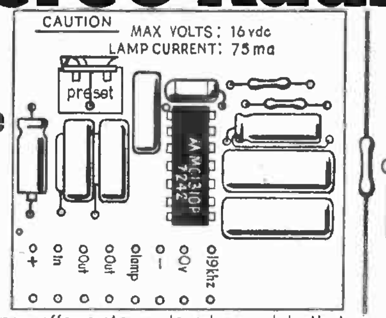
Stereo Radio



update your tuner.

Jermyn now offer a stereo decoder module that simply and easily converts your existing mono tuner for stereo reception. Multiplex output equipped tuners simply have the module plugged in, older types need the de-emphasis capacitor disconnected.
The unit will do justice to the most expensive equipment and has the following specification.

Channel separation:	Typically 40dB
Distortion:	Typically 0.3% at 560mV RMS Composite input signal
Stereo switching:	Automatic with lighted indicator
Power supply:	10-16 volts.

Assembled and fully tested with a no-strings 12 month guarantee the module costs an astonishing £6.90. Excluding VAT. (Also available as a Kit at £4.90.) Beat that!

To Jermyn Industries
164 Vestry Estate
Sevenoaks Kent

BARCLAYCARD

PHF1

Please rush me ☐ Kit(s), ☐ made up Stereo decoders.
I enclose cheque/postal order for £

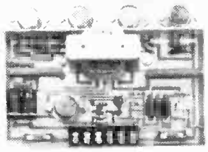
Name

Address

Block Capitals Please

TUAC

NEW TUAC POWER MODULES. Now in their second successful year offering more power and quality than ever before.



TP100 Illustrated **£17·25**
- ★ 125 Watts RMS continuous sine wave output
- ★ 4 RCA 150 Watt 15 Amp output transistors
- ★ Special layer wound driver transformer
- ★ Short, open, and thermal overload protection
- ★ Compact size: 7 x 6½ x 3 in.

TL30 **£9·50**
- ★ 30 Watts RMS sine wave
- ★ Full thermal overload protection
- ★ Short and open circuit proof
- ★ Rugged transformer driver

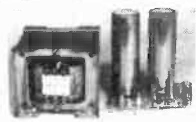
TL100 Illustrated **£13·00**
- ★100 Watts RMS sine wave
- ★2 RCA 15 Amp output transistors
- ★Rugged transformer driver
- ★Full thermal overload protection
- ★Compact size: 5 x 5 x 3 in.

TL60 **£12·00**
- ★ 60 Watts RMS sine wave
- ★RCA 115 Watt output transistors
- ★Only six connections to make
- ★Same size as TL100

Specification on all three power modules :
All output power ratings ±1dB. Output impedance 8–15 Ohms. THD at full power 1% typically 0·5%. Input sensitivity 60mV into 10kΩ. Frequency response 10Hz–25kHz ±2dB. Hum and noise better than −75dB.

Power supplies vacuum impregnated Transformers with supply board incorporating pre-amp supply:

PS 125 ± 50 volts for one TP100	£11·75
PS 100 ± 45 volts for one TL100	£10·75
PS 60 ± 40 volts for one TL60	£9·50
PS 30 + 50 volts for one TL30	£7·00
PSU 2 for supplying Disco Mixer	£4·75

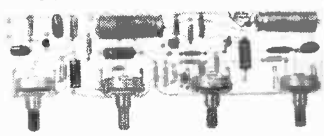


PRE AMPLIFIERS

All Tuac audio modules are constructed on glass fibre P.C. board, are ready assembled and fully tested. Low noise silicon and FET transistors together with H.S. carbon film resistors are used throughout. Extensive research has gone into the various wide range tone control circuits, producing superb sound quality from any signal. Previous range still available. 40V d.c.; 60mV o/p.

VA08	Vol, Treb, Mid and Bass Controls. HI IMP. FET I/P. Suitable Mic, Guitar, Radio, Crystal/Ceramic P.U. Sensitivity 4mV. Treb +35dB at 16kHz, Mid +20–15dB at 1kHz, Bass +20–10bB at 40Hz.	£5·00
VA06	Vol, Treb and Bass Controls. 8mV sensitivity. Treb +28–15dB at 12kHz, Bass ±18dB at 40Hz.	£4·25
AMF01	Tuac Auto Fade Unit fades music when you speak. Auto Mic Over-ride for Disco use. Feed Deck and Mic Pre-amps in. Auto fade O/P to main Amp. 30mV operating level. Depth and Vol. Controls.	£5·00

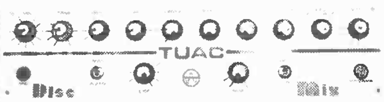
VA08 ILLUSTRATED



SIZE 6½″ x 2″ x 1″

ALL PRICES INCLUDE V.A.T. AND POSTAGE AND PACKING

ACCESS & BARCLAY CARDS ACCEPTED, JUST SEND US YOUR NUMBER. H.P. ARRANGED THROUGH PAYBONDS.



TUAC DISCOTHEQUE MIXER WITH AUTO FADE **£27·00**
Designed for the discerning D.J. of professional standard. Offering a vast variety of functions.
Controls: Mic Vol, Tone, Over-ride depth, Auto Manual Sw. Tape Vol, L & R Deck Faders, Deck Volume. Treb. & Bass. H. Phon Vol, Selector. Master Vol, on/off sw. Max. output 1V RMS. Specification as VA06. **PANEL SIZE 18″ x 4½″ DEPTH 3″**

TUAC HIGH POWER AMPLIFICATION—built to high standards, and built to last

50 WATT RMS SINE WAVE ALL PURPOSE AMPLIFIER
Suitable for Disco, PA, Guitar. 4 inputs, 2 volume controls. Master volume, treble, middle and bass controls. Rugged circuit, rugged leather-cloth covered case, short and open circuit protection. Tone control specification as VA08 pre-amp. FULLY FUSED.

50 WATT £44·00
100 WATT £66·00

NEW FROM TUAC!!
100W 2 × 12 Disco/Group cabs, fitted 2 50W RMS super heavy duty speakers **£66·00** (car. £1·00)
100W 4 × 8 P.A. Cols, fitted 4 15W heavy duty speakers. **£75·00 pair** (carr. £2·00).

TUAC MAIN DEALERS

BRISTOL DISCO CENTRE,
86 Stokes Croft, Bristol 1
Tel. Bristol 41666

CALBARRIE AUDIO
38 Cromwell Road, Luton, Beds.
Tel. Luton 411733

SOCODI,
9 The Friars Canterbury, Kent.
Tel. Canterbury 60948

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SPECIALISTS IN QUALITY TRANSISTOR EQUIPMENT
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TUAC

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01-672 3137/9080

RTVC FOR AUDIO ON A BUDGET

PUSH BUTTON(*) CAR RADIO KIT

The first time* Motor *magazine have nominated a push button car radio for their Top Ten Accessory Awards

NOW BUILD YOUR OWN AWARD WINNING PUSH BUTTON CAR RADIO

Technical specification:

1.) **Output** 2.5 watts R.M.S. into 8 ohms. For 12 volt operation on negative or positive earth.

2.) **Integrated circuit** output stage, pre built three stage IF Module.

Controls Volume, manual tuning and five push buttons for station selection, illuminated tuning scale covering full medium and long wave bands.

Size Chassis 7 ins. wide, 2 ins. high and $4\frac{5}{16}$ ins. deep approx.

NOTE: The ability to solder on a printed circuitboard is necessary to complete this kit successfully. Circuit diagram and comprehensive instructions 55p.free with kit.

Car Radio Kit
£6.60 + 55p. postage & packing.

Speaker including baffle and fixing strips
£1.65 + 23p. postage & packing.

Recommended **Car Aerial** - fully retractable and locking.
£1.35 post paid.

STEREO 21

QUALITY SOUND(*) FOR LESS THAN £19·00

Stereo 21 easy to assemble audio system kit, – no soldering required. Includes:–

BSR 3 speed deck, automatic, manual facilities together with ceramic cartridge.

Two speakers with cabinets.

Amplifier module. Ready built with control panel, speaker leads and full, easy to follow assembly instructions.

For the technically minded:–

Specifications:

Input sensitivity 600mV:Aux. input sensitivity 120mV: Power output 2.7 watts per channel: Output impedance 8–15 ohms. Stereo headphone socket with automatic speaker cutout. Provision for auxiliary inputs – radio, tape, etc., and outputs for taping discs. **Overall Dimensions.** Speakers approx. $15\frac{1}{2}'' \times 8'' \times 4''$. Complete deck and cover in closed position approx. $15\frac{1}{2}'' \times 12'' \times 6''$. Complete only **£18.95** + £1.60 p & p.

Extras if required.

Optional Diamond Styli **£1.37**

Specially selected pair of stereo headphones with individual level controls and padded earpieces to give optimum performance. **£3.85.**

DISCO AMPLIFIER

Reliant Mk IV Mono Amplifier, ideal for the small disco or house parties.

Outputs 20 watts R.M.S. into 8 ohms (suitable for 15 ohms).

Inputs *5 Electrically Mixed Inputs. *3 Individual Mixing controls. *Separate bass and treble controls common to all 5 inputs. *Mixer employing F.E.T. (Field Effect Transistors). *Solid State Circuitry. *Attractive Styling.

INPUT SENSITIVITIES

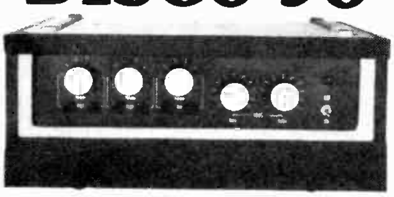
1) Crystal Mic or Guitar 9mV. 2) Moving coil Mic or Guitar 8mV. 3), 4), 5) Medium output equipment (Gram. Tuner, Monitor, Organ, etc.) – all 250mV sensitivity.

AC Mains 240V. operation.

Size approx. $12\frac{1}{4}$ ins × 6 ins × $3\frac{1}{2}$ ins

£15.00 + 60p. postage & packing

DISCO 50

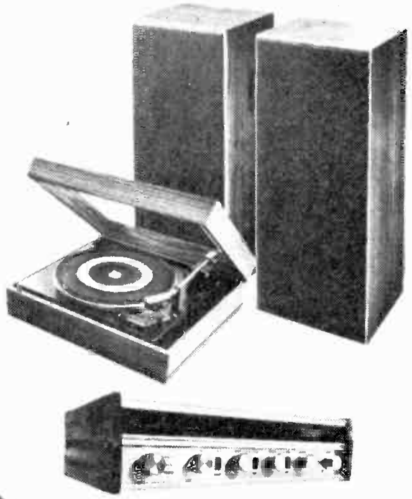


45 WATT R.M.S. MONO DISCOTHEQUE AMPLIFIER

Ideal for Disco Work. Output Power: 45 watts R.M.S. Frequency Response 3dB points 30Hz and 18KHz. Total Distortion: less than 2% at rated output. Signal to noise ratio: better than 60dB. Bass Control Range: 13dB at 60Hz. Treble Control Range: 12dB at 10KHz. Inputs: 4 inputs at 5mV into 470K. Each pair of inputs controlled by separate volume control. 2 inputs at 200mV into 470K. Size: $19\frac{1}{4} \times 10\frac{1}{2} \times 8$ins. approx. Amplifier **£27.50+£1.50 p. & p**

Special Offer: Disco 50 plus two 15″ E.M.I. speakers type 14A/780 (as illustrated on opposite page). **Complete £57.00+£4.00 p&p.**

COMPLETE(*) STEREO SYSTEM



£51·00

40 Watt Amplifier.
Viscount III - R102 now 20 watts per channel.
System I includes,
Viscount III amplifier – volume, bass, treble and balance controls, plus switches for mono/stereo on/off function and bass and treble filters. Plus headphone socket.
Specification
20 watts per channel into 8 ohms.
Total distortion @ 10W @ 1kHz 0·1%. *P.U.1* (for ceramic cartridges) 150mV into 3 Meg. *P.U.2* (for magnetic cartridges) 4mV @ 1kHz into 47K. equalised within 1dB R.I.A.A. *Radio* 150mV into 220K. (Sensitivities given at full power). Tape out facilities: headphone socket, power out 250mW per channel. *Tone controls and filter characteristics*. Bass: +12dB to −17dB @ 60Hz. Bass filter: 6dB per octave cut. Treble control: treble −12dB to −12dB @ 15kHz. Treble filter: 12dB per octave. *Signal to noise ratio*: (all controls at max.) −58dB.
Crosstalk better than 35dB on all inputs.
Overload characteristics better than 26dB on all inputs. Size approx. 13¾″ × 9″ × 3¾″.
Garrard SP25 deck, with magnetic cartridge, de luxe plinth and hinged cover.
Two Duo Type II matched speakers – Enclosure size approx. 17½″ · 10¾″ × 6″ in simulated teak. Drive unit 13″ × 8″ with parasitic tweeter (10 watt handling)

Complete System £51.00

£69·00

System II
Viscount III amplifier (As System I)
Garrard SP. 25 (As System I)
Two Duo Type IIIA matched speakers– Enclosure size approx. 31″ × 13″ × 11½″. Finished in teak veneer. Drive units approx. 13½″ × 8¼″ with 3¼″ HF speaker. Max. power 20 watts, 8 ohms. Freq. range 20Hz to 20kHz.

Complete System £69.00

PRICES: SYSTEM 1

Viscount III R 102 amplifier	£24·20 + £1 p & p
2 Duo Type II speakers	£14·00 + £2·20 p & p
Garrard SP25 with MAG. cartridge de luxe plinth and hinged cover	£21.00 + £1.75 p & p.
total	£59.20

Available complete for only £51.00 + £3·50 p. & p.

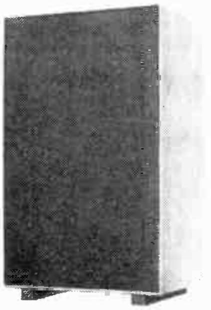
PRICES: SYSTEM 2

Viscount R102 amplifier	£24·20 + £1·00 p. & p.
2 Duo Type IIIA speakers	£39·00 + £4·00 p. & p.
Garrard SP25 with MAG cartridge de luxe plinth and hinged cover	£21·00 + £1·75 p. & p.
total	£84·20

Available complete for only £69.00 + £4 p & p.

EMI SPEAKERS AT FANTASTIC REDUCTIONS

THE ULTIMATE COMPLETE SPEAKER SYSTEM
EMI LE 315 listed price £86·00



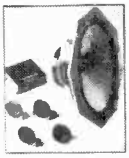
A professional standard five way speaker system with enclosure giving top quality performance.
Enclosure Dimensions
approx. (3ft. · 2ft. · 1ft.)
Drive Units
Hand built – 15″ diameter bass with 3″ voice coil, – two 5″ diameter Mid Range units, – two 3¼″ HF units, plus matching crossover panel with two variable potentiometers for mid and high frequency adjustment.
Power Handling
Continuous rating 35 W rms., Peak power rating 70 W.
Frequency Response
20 Hz 20,000 Hz. Imp. 8 ohms.

Our price £45·00 + £3·50 p. & p. Recommended retail price £86·00

15″ 14A/780 BASS UNIT

Bass unit on a rigid diecast chassis. Superior cone material handles up to 50 watts RMS, and is treated to give a smooth frequency response. Resonance 30 Hz. flux density 360,000 Maxwells. Impedance at 1 kHz is 8 ohms. 3″ voice coil.

Recommended retail price £40·80.
OUR PRICE £18·70 + £1·50 p & p



950 KIT

Five matched speakers and crossover unit for handling up to 45 watts, frequency response from 20 to 20,000 Hz.
Huge 19″ × 14″ (approx.) high efficiency Bass-Speaker with 16,500-gauss magnet built on a heavy diecast frame.
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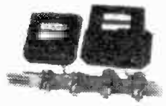

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- ✲ Constant acts as last entry in a calculation.
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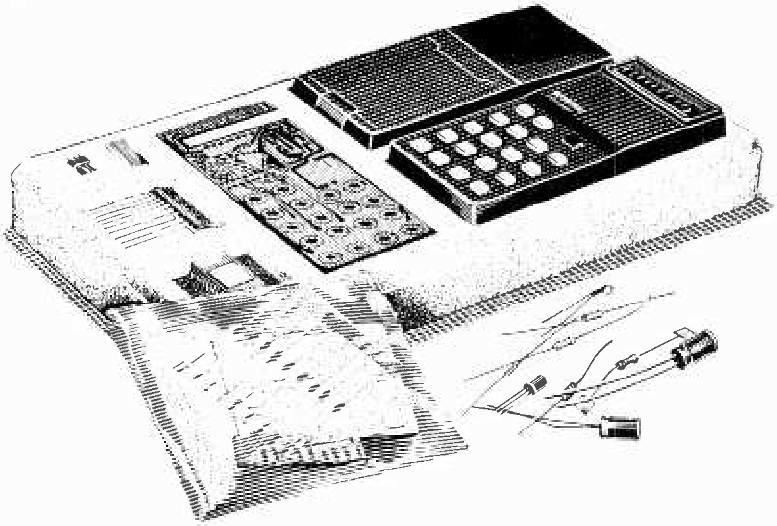

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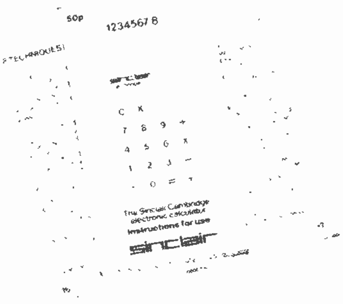

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PLEASE PRINT

CURIOSITY!

WHENEVER some new idea or application appears on the public scene, we are often asked if we are going to publish a full project design so that constructors can make one. It may be that such an application has no existing off-the-shelf version that can be purchased by anyone.

Over the past year there has been a steady growth in the appearance of slot machines that offer two games of "tennis" or "football" for 10p. In the past six months they have been popping up like mushrooms, in pubs, restaurants, hotels, clubs, discotheques, railway stations and so on. Maddening, isn't it! There you are, confronted by a television screen and this white blob drifting about at random angles across the screen. How does it work? Can we make one for domestic television sets?

We hope that most of your questions on this subject, that have been coming to us recently, will be answered now. In this issue we start a do-it-yourself project that enables a domestic television set to be used to play "tennis". The principles employed are similar to the commercial version but the circuit design detail is totally original. We have carried out considerable work on this kind of project and have come up with a straightforward design for connection direct into the aerial socket of a u.h.f. 625-line receiver. We must however warn constructors that it is not cheap to make and it is important that the published design detail must be strictly followed to avoid problems that can occur in using digital integrated circuits.

Having said this we sincerely hope that the lesser experienced constructor will not be frightened off by the amount of hardware used, because the project is not difficult to build if you take care at every stage and avoid using unknown or doubtful alternative components.

For the more experienced constructor who wants something of a challenge, we recommend that you follow the design starting in the July issue of "Television". By following through all stages you can make a "tennis" game (not the same design as that in P.W.) then progress to football and possibly golf. In the latter, the circuitry is more involved enabling you to move the players into any position on the "field". The design in *Television* depends on some connections being made inside the television set and you should have some knowledge or experience in television before tackling it.

With these two designs we hope to have satisfied a great deal of curiosity that has been aroused. They represent for both magazines a significant achievement in development that, so far as we are aware, is unparalleled in any other magazine. They are original in detail and a "double-first" for do-it-yourself magazines.

M.A. COLWELL—Editor

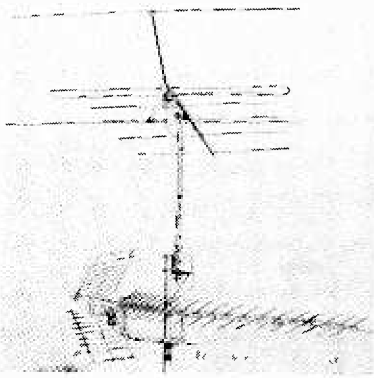
The August issue sees another milestone for P.W.; the first of the "P.W. Super Separates" is a headphone amplifier—a top design by a top designer. Later in this series there will be a modern design f.m. stereo tuner with high sensitivity for long distance reception. Also in the August issue, we have a converter for the two-metre band. You cannot afford to be without Practical Wireless.

Further details on page 231

(All advanced details are subject to the current industrial situation)

NEWS...

Fuba-Goon!



Peter's aerial system.

FUBA aerials (Audio Workshops Ltd.) have been supplied to Peter Sellers in his London home.

The requirement was for a top quality u.h.f. aerial signal in both colour and black and white to supply four outlets and to provide an excellent v.h.f./f.m. signal for home and continental reception.

It was decided to fit a Fuba XC 381 B u.h.f. aerial to cater for the three London channels, and a UKA Stereo 8 array with automatic rotator to cater for the f.m. requirement. Problems were encountered with reflections from nearby power station chimneys and other high buildings, but fitting the aerials on to a 15ft x 2in mast overcame the main difficulties.

The Fuba UKA 8 f.m. was fitted to a 3ft stub mast on a rotator on top of the 15ft mast. The u.h.f. array was sited below the rotator and set for best possible results.

Audio Workshops Ltd. of Robertsbridge, Sussex are the sole UK distributors of Fuba Aerials. *Audio Workshops Ltd., 29 High Street, Robertsbridge, Sussex.*

CQ column

THE CQ column is a valuable way of obtaining back numbers from other readers, but please reimburse expenses and the price of the magazines to those who have kindly offered to help!

NEWS... NEWS... NEWS...

MinPosTel

THE Ministry of Posts and Telecommunications has been abolished. Mr. Anthony Wedgwood Benn the Secretary for Industry, becomes responsible for the Post Office.

Those parts of the MinPosTel relating to the Wireless Telegraphy Acts are under the wing of the Home Office and Mr. Roy Jenkins.

Queen's Award

THE BBC announces that it has received the Queen's Award to Industry for the second time in five years. The award is for technological innovation in the transmission of sound and vision signals over a single vision link and relates to an original development by engineers of the Corporation's Research and Designs Departments.

Stars at Henry's of Harrow

PETER SELLERS ably assisted by the Wombles of Wimbledon was the star attraction at the Gala opening of Henry's Hi-Fi Centre at Harrow recently.

Thousands of people turned up to see the festivities and in particular Peter Sellers—who lapsed into inspired "goonery" for a radio interview with Douglas Cameron of London Broadcasting. The Wombles set about encouraging the audience to tidy up the streets of Harrow just as they themselves do to Wimbledon Common!

After he had cut the ceremonial tape to officially declare the Hi-Fi Centre open, Peter Sellers then drew the winning entries for the Henry's Hi-Fi Contest in which £300 of Hanimex stereo/audio equipment was given in prizes. Lucky winner was Mrs. Joanne Courtney, of Pinner View, Harrow. She won a complete stereo outfit and four runners-up each received cassette players. The contest was run in conjunction with London Broadcasting who gave live coverage to the opening.

Delighted at the crowds who turned up for the opening Henry's Retail Director, David French remarked "You can't beat the old-time showmanship when it comes to attracting the crowds. At times it was reminiscent of Beatlemania outside the store".

He had good reason to be pleased. The new Centre opened to bumper business and after the stars had left, the people of Harrow got down to the serious business of inspecting the vast range of hi-fi equipment on display.

The Hi-Fi Centre at Harrow is the first in a series of suburban developments by the Henry's radio group—which has hitherto had a concentration of shops in Central London.

Peter Sellers and the Wombles at Henry's.

Arthur Bulgin, O.B.E.

FOLLOWING a short illness Mr. Arthur F. Bulgin, O.B.E., died at his home in Westcliffe on the night of Friday, 29th March, aged 75 years.

He was a well-known personality not only in Barking, Essex., where A. F. Bulgin & Co. Ltd. manufactures an extensive range of electrical and electronic component parts, but also in the electronics industry, being one of the six founders in 1932 of the Radio & Electronic Component Manufacturers Federation. Mr. Bulgin's passing marks the end of 51 years in the industry.

The chairmanship of the company now continues with his son, Mr. Ronald Bulgin who also shares joint managing directorship with A.F.B.'s brother, Mr. Stanley Bulgin.

Mr. Ronald Bulgin, M.A., C.Eng., M.I.E.E., has been with the company for over sixteen years. At the present time he is also chairman of the Radio & Electronic Component Manufacturers Federation.

SORRY WE ARE LATE!
We apologise for the late appearance of Practical Wireless. The delay has been caused by an industrial dispute within the printing industry.

THE 'SEVERN' PORTABLE

F. G. RAYER
G3OGR

WITH a multi-band receiver it is convenient to have a ferrite rod aerial for long and medium wave reception and a telescopic aerial for the short wave bands, with provision for connecting an external aerial when necessary. This receiver is this type and the four bands tuned are approximately as follows:

(1) 160-260kHz long wave.
(2) 575-1450kHz medium wave.
(3) 1·8-5·0MHz shipping and short wave.
(4) 5·7-15MHz general short wave.

The receiver has an inexpensive but robust case with a bottom compartment for holding logs of transmissions or other records. Five tuned IF circuits give good selectivity while the output stage provides adequate volume for ordinary purposes.

MIXER STAGE

Switching is used to select any of the four bands and this unavoidably results in some complication of the frequency changer circuit. Despite this, there should be no particular difficulty, especially as the receiver can be tested with coils for one band only before adding the other connections for full coverage.

Fig. 1 shows the mixer stage in which a 7-pole 4-way switch is used. Operation will become clear if each section is dealt with separately.

When an external aerial is used it is taken to socket A1 and in LW and MW positions of S1 is connected to the winding L4 on the ferrite rod. For normal MW or LW reception no external aerial is needed. In the other positions, S1 takes the aerial to the coupling windings L7 or L10 on the SW ranges.

Section S2 of the switch transfers the aerial tuning capacitor VC1 to L1/L2 for LW/MW reception or to L5 or L8 on SW. Aerial connection A2 is for a telescopic aerial. To ensure that there is no loss of efficiency due to errors in alignment, when aerials are changed, the panel trimmer VC3 is provided to peak this circuit. S3 transfers the base to L3 for MW and LW reception or to the base coupling windings L6 and L9 for SW. S4 short circuits the LW coil L2 for MW reception and for LW reception, S4 brings in C2 with the trimmer TC2, for appropriate coverage of the LW/MW oscillator coil L11.

Switch section S5 selects the appropriate collector coupling winding of the oscillator coils, L12 for LW/MW and L15 or L18 for the short wave ranges. S6 similarly switches the emitter circuits. The emitter bias resistor R6 in series with the LM/MW winding L13 is different value from R5, used for both SW bands, permitting optimum results.

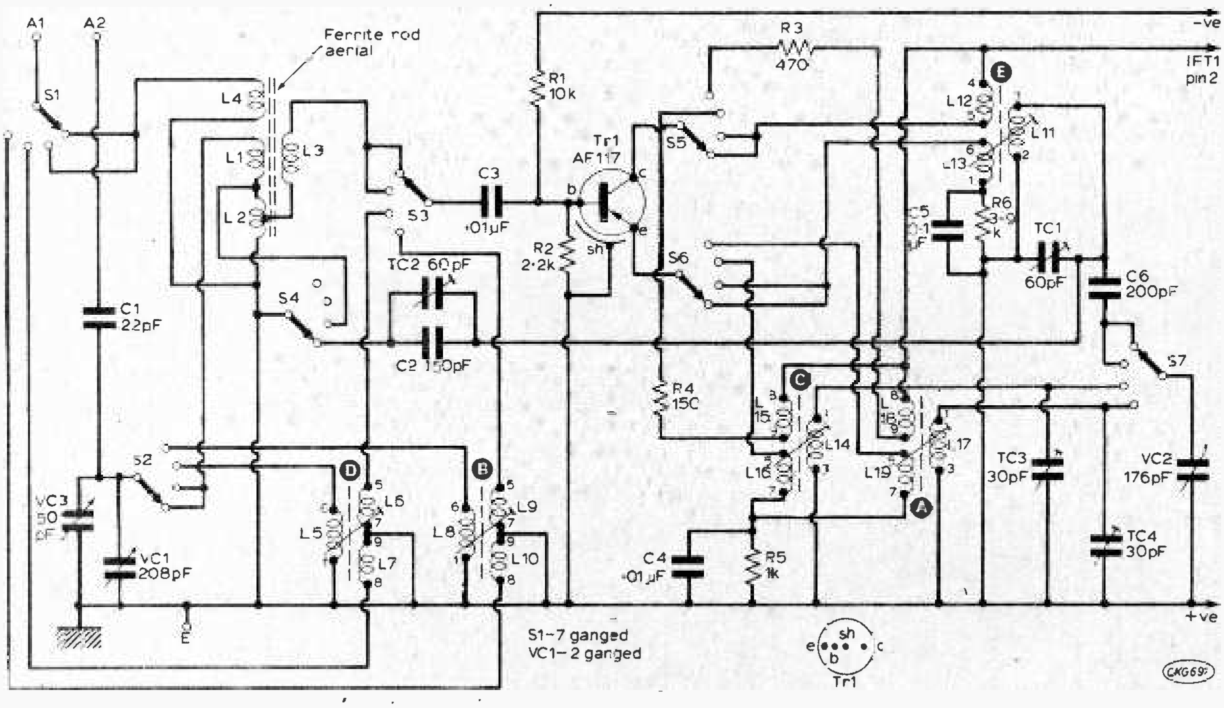
Switch section S7 transfers the oscillator tuning capacitor VC2 to the appropriate windings. C6 is a padder for the LW/MW coil L11, and TC3 and TC4 are trimmers on the SW coils L14 and L17.

A socket E allows an earth to be connected which is helpful when bringing in weak signals, in the 1·8-5MHz range in particular. Much general listening is of course possible on all frequencies with no external aerial. But reception of weak amateur and other signals on 1·8-2·0MHz, 3·5-3·8MHz and other bands will be greatly improved by an external aerial.

IF AMPLIFIER

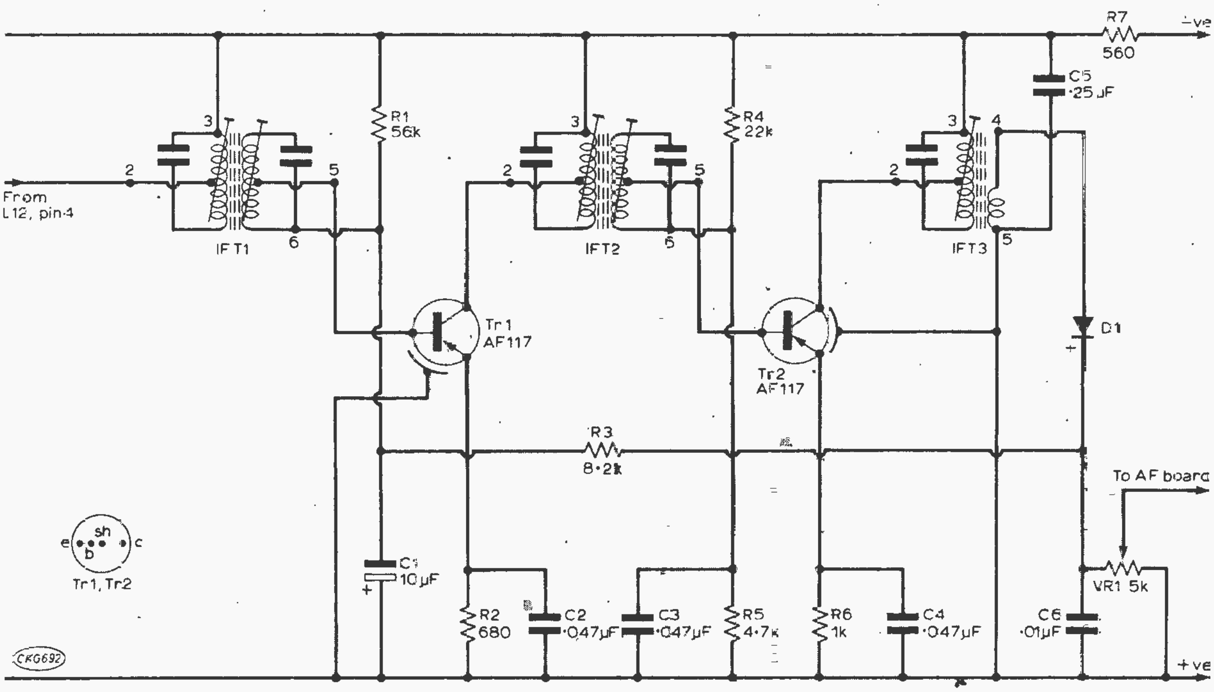
This is assembled on a separate board, using the circuit in Fig. 2. IFT1 and IFT2 are double tuned, but in IFT3 only the primary is tuned. As these IFT's are pre-aligned the cores should be left as they are, pending any slight final adjustment for best results.

This circuit gives very good sensitivity and selectivity. Audio output is taken from D1 to the volume control. The positive or earth line will go to the metal panel of the receiver when the amplifier is



▲ *Fig. 1. Circuit of the mixer stage with four switched ranges covering 160kHz to 15MHz.*

▼ *Fig. 2. Two stage IF amplifier circuit with diode detector which drives the audio amplifier, Fig. 3.*



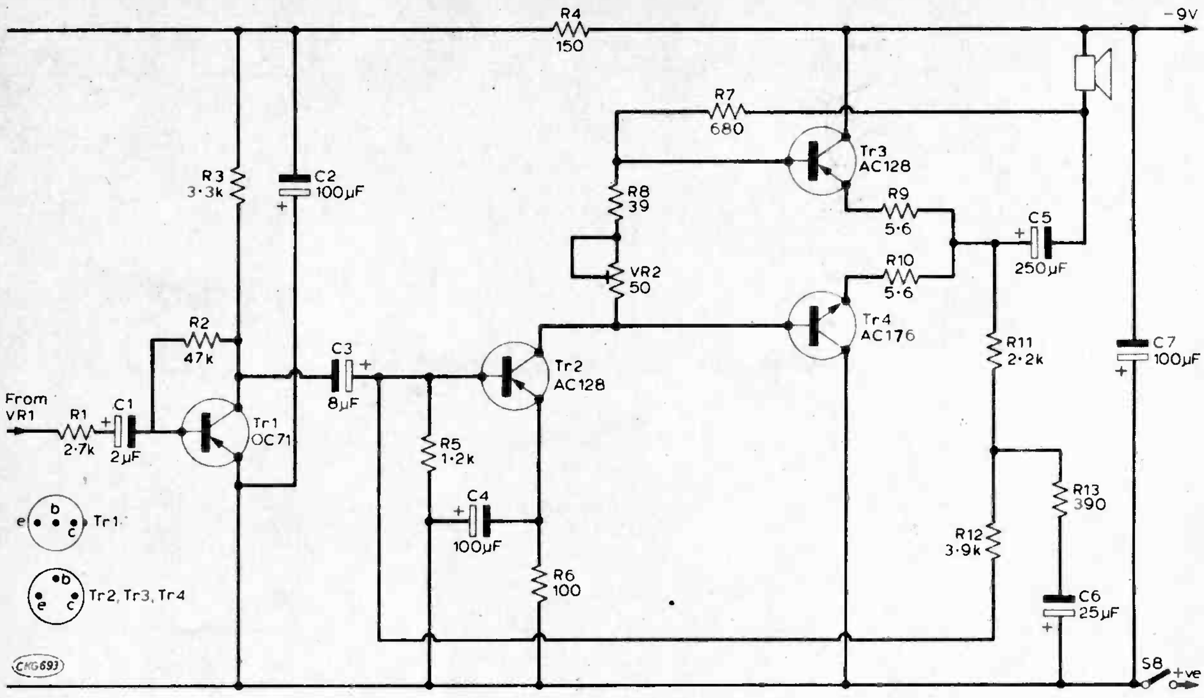


Fig. 3. Four transistor audio amplifier circuit completes the Severn portable receiver.

mounted. Other external connections are from pin 2 of IFT1 to the mixer and from pin 3 of IFT1 to the negative line of the mixer section. A lead from R7 will run to a supply point provided on the audio amplifier.

AUDIO AMPLIFIER

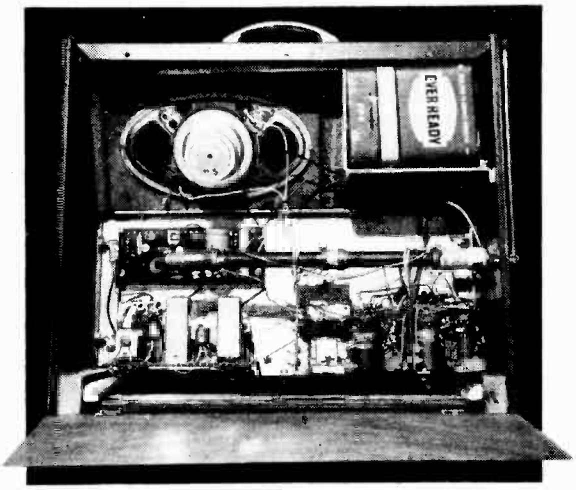
Fig. 3 is the circuit of this section of the receiver, assembled on a separate board. Audio signals from the volume control VR1 pass to the pre-amplifier Tr1. Tr2 is the driver for the complementary output stage Tr3/Tr4 and direct current feedback through the network R11 and R12 stabilises working conditions of driver and output stages. R13 with C6 introduce frequency compensation in audio feedback through this circuit.

Initially the pre-set VR2 is adjusted so that current drawn by the amplifier is about 7mA to 9mA with no audio signal. This is not a critical adjustment and the amplifier can be expected to give adequate power output with good quality of reproduction. As is usual with circuits of this kind, current drawn depends on the volume and will rise to peaks of 20mA to 40mA or so when volume is adjusted to a high level. A 15ohm speaker is most suitable for this circuit but the speaker should not be under 8ohms. With speakers of considerably higher impedance, such as 30ohms, volume and current consumption are somewhat reduced.

In view of the fact that the receiver may be used for amateur band or other SW listening purposes when headphones are preferred, a jack outlet can be fitted. A 15ohm resistor is wired across this and any high or medium impedance headset plugged in.

PANEL

A 10 x 4in flanged universal chassis member is drilled to fit the tuning capacitor 4in from the end, as in Fig. 4. Space it back slightly with washers so that the drive can fit correctly. The cursor against which the dial is read is a strip of Perspex about 3 x ½in, with a vertical line, fixed with 8BA bolts.



General view from the rear of the completed set.

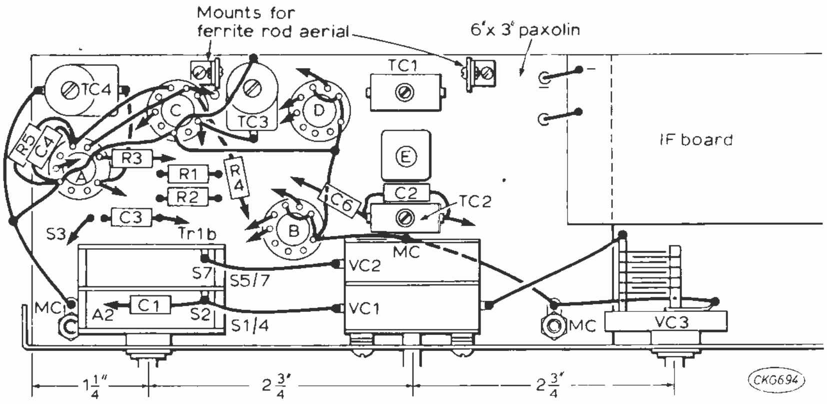


Fig. 4. Layout of mixer stage. Transistor Tr1 is located to the rear of switch wafer S5-7 and wired directly to the switch tags. See photograph.

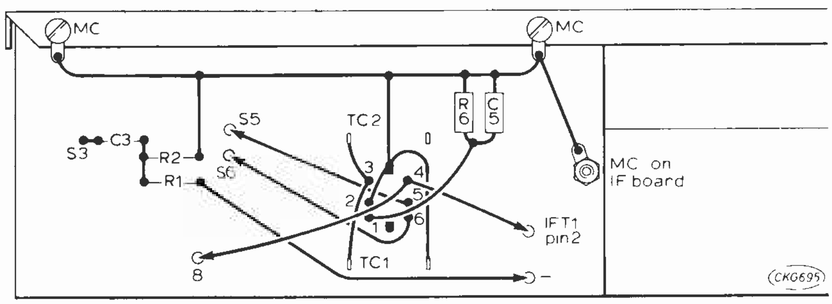


Fig. 5. Wiring underneath the mixer stage board. It may be necessary to drill holes to clear the adjusting screws on TC1 and TC2.

The switch and VC3 are $2\frac{3}{4}$in from VC1/2. Drill a 6 x 3in paxolin board and the lower flange so that these can be bolted together as in Figs. 4 and 5. The tags MC are for connections to the metal chassis.

MIXER ASSEMBLY

As the full band switching results in quite a lot of wiring, this is probably the most difficult section. Referring to Fig. 4, A is the Range 4 oscillator coil and B the Range 4 aerial coil, C is the Range 3 oscillator coil and D the aerial coil. E is the LW/MW oscillator coil and its pins are wired underneath as in Fig. 5.

Connections to the switch are shown in Fig. 6. S1, S2, S3 and S4 are on the wafer nearest the panel, seen from behind. S5, S6 and S7 are similarly the contacts of the rear wafer. As contacts for sections S3 and S4, in particular, cannot be reached when the switch is fitted, lengths of thin insulated connecting wire should be soldered on first. It is of course essential that switch connections are correct. There should be no difficulty in seeing how the switch works. If there is, check its operation with a meter or any other means of indicating continuity, for each position in turn.

S2 and S7 are near VC1 and VC2, as in Fig. 4. All other leads should be reasonably short and direct. Place Tr1 near the rear wafer with collector to S5 and emitter to S6, Fig. 6. Take the base lead down to C3, Fig. 4, and the screen lead to the positive line. It may be preferred to wire in coils A and B only, at first, and to test the receiver, adding the other bands afterwards.

Leave flying leads from C1 and S1 for aerial connections later. Also provide leads to run to the IF board.

FERRITE AERIAL

Two small brackets are bolted as in Fig. 4, holding vertical strips of paxolin about $2\frac{1}{2} \times \frac{1}{2}$in each with a notch in the top to take the aerial rod which is secured with thread or elastic through holes in the strips.

The MW winding lies over TC4, its large winding is L1 and small winding L3. The LW winding has a tapping, and it is necessary to connect this coil so that the tapping is electrically near the earthed end.

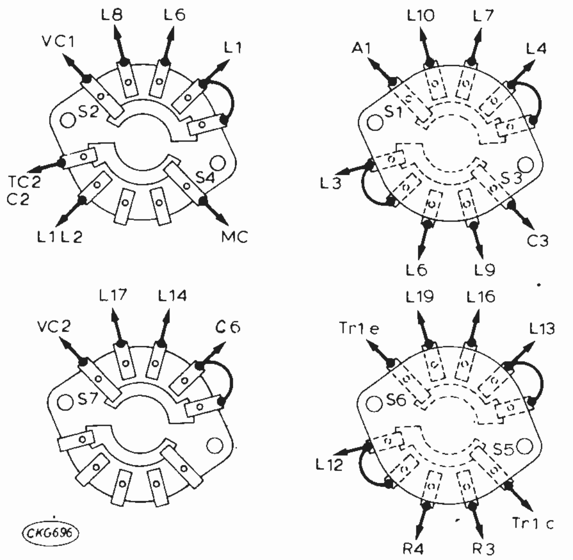


Fig. 6. Connections to switches S1-4 on the front wafer and S5-7 on the rear wafer.

Should it subsequently prove impossible to align the aerial circuit on long waves, slide the LW winding off the rod, turn it over, then replace it. The external coupling winding L4 can be anywhere near the centre of the rod and its leads are connected from S1 to MC.

IF BOARD WIRING

The IF board is $3\frac{1}{2} \times 1\frac{3}{4}$in and Fig. 7 shows both sides. Drill holes for the IFT pins and screening can tags not forgetting a central hole to allow the lower cores to be reached for tuning. A very small round file will be helpful if some holes are not quite exactly placed.

Two tags MC are fixed with $\frac{1}{2}$in 6BA bolts for chassis returns. Connect up according to Fig. 7, placing sleeving on any leads where this is necessary. C1 and D1 must be wired in with the correct polarity. This section is very straightforward and there is plenty of space for components.

The completed amplifier can be tested before fitting by connecting the volume control from the pin VR1 to MC and placing the lead from a signal generator near to pin 2 of IFT1. Audio output from the diode can be checked with phones or an audio amplifier. With low input from the generator the five cores can be adjusted for best results, using a correctly fitting tool (such as the TT5, available from the IFT maker). Only a very small adjustment should be necessary for any core.

The IF board is mounted by passing the one bolt through a hole in the mixer board, Fig. 5. At the other end of the IF board a strip of metal runs from the MC tag bolt to the flange of the panel, to which it is secured.

AUDIO BOARD WIRING

This board is $3\frac{3}{4} \times 1\frac{1}{2}$in and is wired as in Fig. 8. Two bolts with tags again provide MC return points. Veropins are inserted for external connections to speaker, battery negative, R1 and for the negative lead from the IF board.

★ components list

MIXER BOARD

Resistors

R1	10kΩ	R3	470Ω	R5	1kΩ
R2	2·2kΩ	R4	150Ω	R6	3·9kΩ

Capacitors

C1	22pF	C3	0·01μF	C5	0·01μF
C2	150pF SM	C4	0·01μF	C6	200pF SM

VC1/2 208+176pF (Jackson Type 00)
VC3 50pF variable (Jackson Type C804)
TC1/2 60pF preset TC3/4 30pF preset

Inductors

Blue range 3T and 4T. Red range 3T and 4T (Denco—For transistor usage)
MW/LW Oscillator coil (Denco TOC1)
MW/LW Ferrite rod aerial (Denco)

Miscellaneous

Tr1, AF117. Switch, 7(8) pole, 4 way on two wafers (each wafer 4 pole 4 way). Paxolin sheet, 6 x 3 in. Slow motion drive (Jackson 4489/C).

IF BOARD

Resistors

R1	56kΩ	R4	22kΩ	R7	560Ω
R2	680Ω	R5	4·7kΩ	VR1	5kΩ log. pot. with switch S8
R3	8·2kΩ	R6	1kΩ		

Capacitors

C1	10μF 6V	C3	0·047μF	C5	0·25μF
C2	0·047μF	C4	0·047μF	C6	0·01μF

Semiconductors

Tr1 AF117 Tr2 AF117 D1 OA81

Miscellaneous

IFT1/2 (Denco IFT18/465). IFT3 (Denco IFT14).
Plain veroboard, 0·15in. matrix, $3\frac{1}{2} \times 1\frac{3}{4}$ in.

AUDIO BOARD

Resistors

R1	2·7kΩ	R6	100Ω	R11	2·2kΩ
R2	47kΩ	R7	680Ω	R12	3·9kΩ
R3	3·3kΩ	R8	39Ω	R13	390Ω
R4	150Ω	R9	5·6Ω	VR2	50 or 100Ω WW preset
R5	1·2kΩ	R10	5·6Ω		

Capacitors

C1	2μF 6V	C3	8μF 6V	C5	250μF 10V
C2	100μF 10V	C4	100μF 6V	C6	25μF 6V
		C7	100μF 10V		

Semiconductors

Tr1 OC71 Tr2 AC128 Tr3 AC128 Tr4 AC176

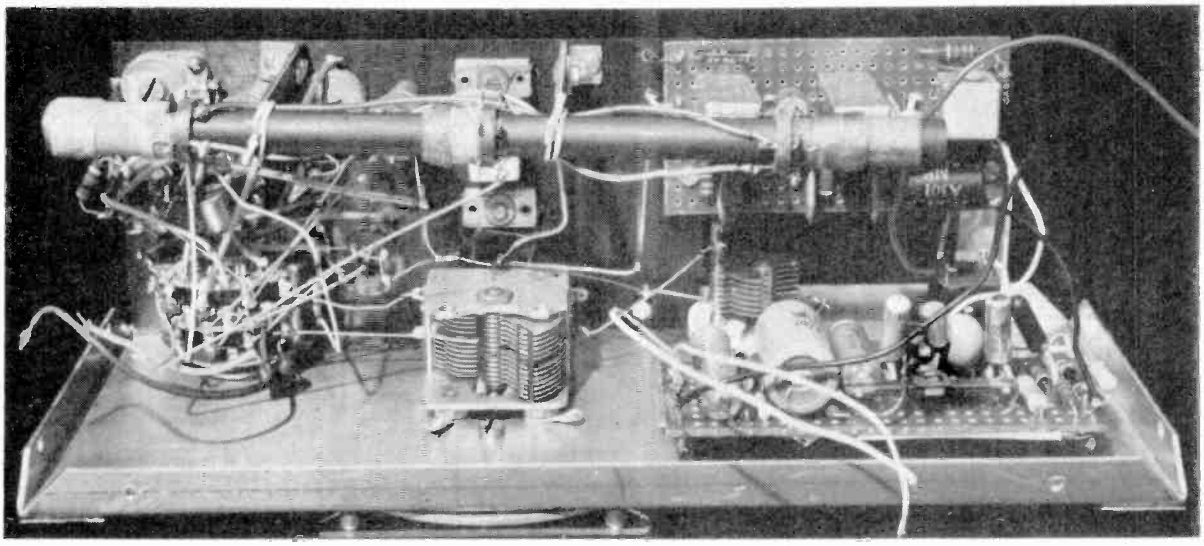
Miscellaneous

Plain veroboard, 0·15 in. matrix, 4 x $1\frac{1}{2}$ in.
Speaker 15Ω, 3 in. (Up to 6 x $3\frac{1}{2}$ in. can be accommodated)

All resistors 5 or 10% $\frac{1}{2}$ or $\frac{1}{4}$W

CABINET ETC.

Panel, 10 x 4 in., flanged universal chassis member
Cabinet top, 10 x 2 in., universal chassis member (Home Radio)
Plywood 6mm. Sides 9 x $3\frac{3}{4}$ in. (2). Baffle 10 x 4 in. Bottom 10 x $3\frac{1}{2}$ in. Back $10\frac{1}{2}$ x $8\frac{1}{2}$ in. Drawer 10 x 1 in. and $8\frac{3}{4}$ x $3\frac{1}{2}$ in.
Telescopic aerial. Knobs. Handle.



In this view of the Severn portable the mixer stage transistor Tr1 can be clearly seen at the rear of the wafer switch, left. The audio board is mounted on the front panel. The IF board is below the right-hand end of the ferrite rod aerial.

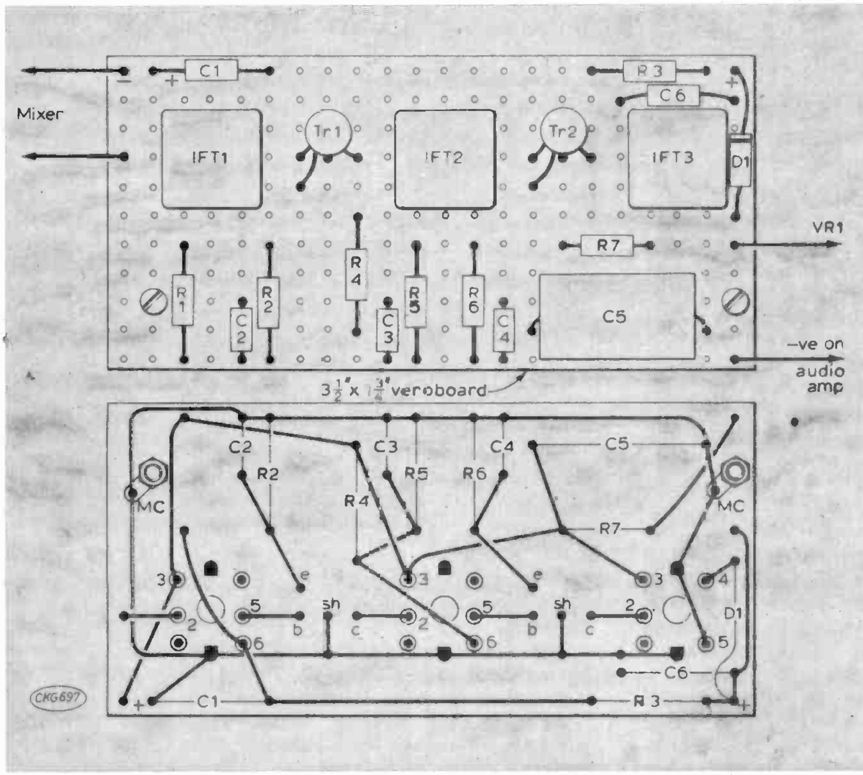


Fig. 7, top, gives location of IFT's and remaining components of the IF amplifier. Below, wiring of IF board. It is very important that the polarity of the diode D1 is correctly observed.

The completed board fits above VC3 and the volume control. To avoid drilling the receiver panel, extra nuts are put on the bolts and locked to a strip/piece of metal which is in turn held in position by the bushes of VC3 and VR1. After the amplifier has been fitted in this way, connections to the IF board, and VR1 and the on/off switch can be completed. The battery supply should not be connected until the speaker is wired to the amplifier.

With the switch set for the highest frequency band, check the coverage obtained. This can be modified at the low frequency end of the band by adjusting the core of L17 and at the high frequency end of the band by adjusting trimmer TC4. The panel trimmer VC3 should peak up signal strength throughout the whole tuning range. Adjust the core of L8 until this is so. VC3 should not be fully open or fully closed, with or without an external aerial or with the telescopic aerial extended. If necessary, TC4 may be re-adjusted to secure this result.

The receiver is then switched to the lower SW range and TC3, L14 and L5 similarly adjusted. The

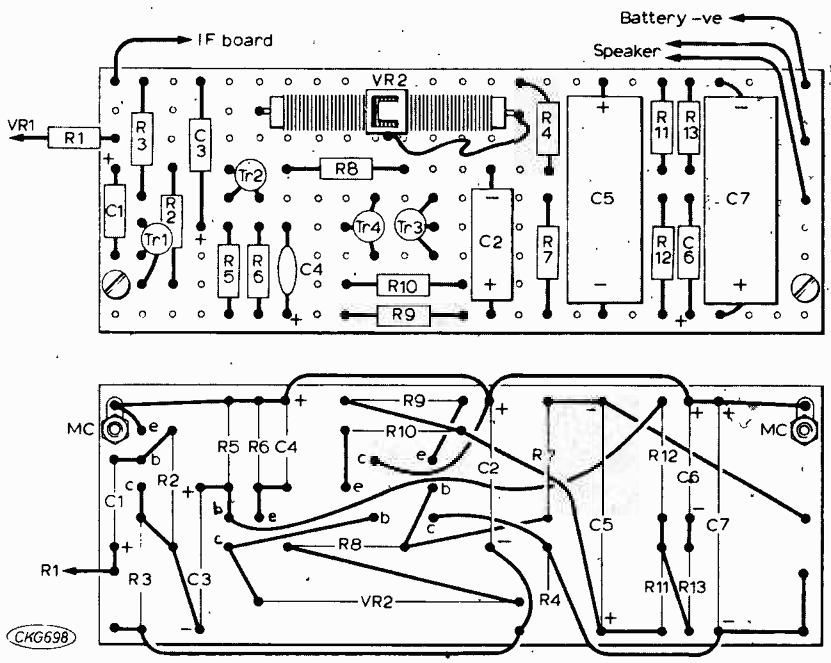


Fig. 8. The two sides of the audio amplifier board. Again, check polarity of the several electrolytic capacitors. VR2 may be replaced by a fixed resistor whose value may be found by first wiring in a potentiometer and adjusting it as described in the text.

next switch position is for MW reception and band coverage depends on L11 and TC1. Subsequently, move L1 on the ferrite rod for maximum volume when receiving signals near the LF end of the band (VC1/2 nearly closed). With correct alignment, very little re-adjustment of VC3 will be necessary, when tuning through the range.

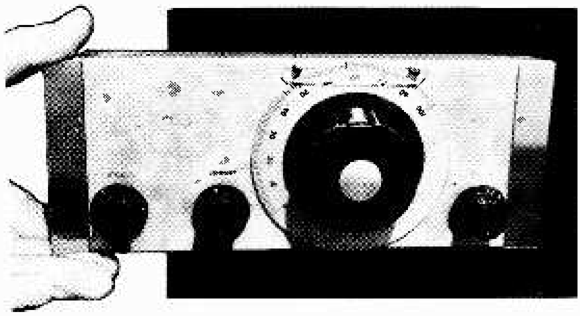
The final position is for LW reception and alignment is obtained by moving L2 on the rod and adjusting TC2. The windings can be fixed with adhesive, when correctly positioned and coil cores may be locked with 6BA nuts.

CABINET

Each side of the cabinet is plywood 9 x $3\frac{3}{4}$in and cut back to $2\frac{1}{4}$in at the top to form a slope 4in long. Two 6BA bolts each side secure the 10 x 2in universal chassis flanged member which is flush with the back and $\frac{1}{8}$in from the top. This member is covered with self-adhesive material before fitting.

Secure the receiver 1in from the bottom, also inset about $\frac{1}{8}$in, with two bolts each side. A piece of plywood 10 x 4in with top and bottom edges bevelled is cemented to the plywood sides only. Corner strips cemented inside will strengthen this. Cut a 3in dia speaker aperture, sandpaper and varnish this baffle before fitting. Cover the hole inside with speaker gauze. Screw on the speaker from behind, using a piece of hardboard with aperture if necessary, and checking that screws cannot penetrate the front.

The bottom is 10 x $3\frac{1}{2}$in plywood, cemented in, with the back $10\frac{1}{2}$ x $8\frac{1}{2}$in hinged to it. Two self-tapping screws through the back into the top runner hold the back closed. Screw a carrying handle to the top. The drawer is plywood, sliding between strips cemented to the case sides and the case bottom and is 1in deep.



The finished chassis before mounting in the cabinet.

A strip of scrap metal about 7 x 1in is bent to hold the PP9 battery which is placed with its fasteners towards the wooden side. This strip is held by a screw securing the carrying handle, and screws into the side.

A black socket on the side is used for Earth and is connected to the panel by a tag held by one of the fixing nuts. A red socket for an external aerial is connected to S1. C1 may be connected to a telescopic aerial mounted on the side of the case. Alternatively, fit another socket, so that a short aerial, consisting of a few feet of flexible wire, can be plugged in here, for short wave reception. It is possible to remove the receiver without disturbance to the cabinet by unscrewing the four bolts holding the panel. ■

look! electronics really mastered

... practical
... visual
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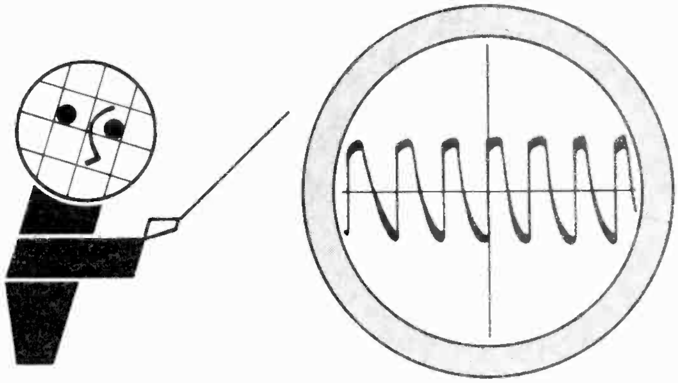

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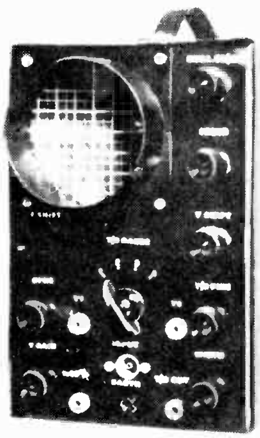

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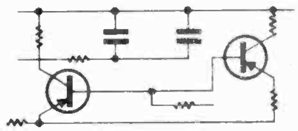

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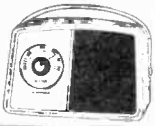

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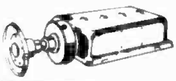

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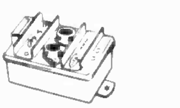

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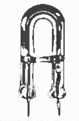

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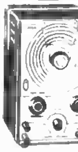

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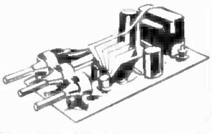

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I.C. OF THE MONTH

Number 45 — **SGS TBA651 RADIO TUNER**

DURING the past few years many new types of integrated circuits have been introduced which are specifically designed for use in radio receivers. The use of such devices enables smaller, high performance radio receivers to be produced. In addition, the reduced number of components results in the labour cost of assembling the receivers being minimised.

Description

The TBA651 contains the RF, oscillator, mixer and IF stages of a conventional type of superheterodyne receiver in a single integrated circuit. In addition, it contains a voltage regulator which keeps the performance almost constant as the supply voltage and/or temperature vary.

It is not possible to include tuned circuits on the silicon chip so they must therefore be connected externally to the device. In addition, some decoupling capacitors are required as well as a detector and an audio amplifier.

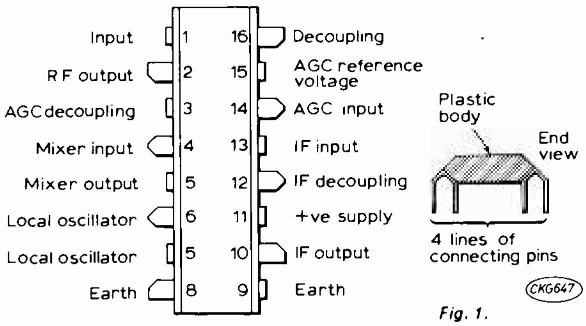

Fig. 1.

The TBA651 can be used in high quality domestic radio receivers and in car radio receivers for amplitude modulated signals at input frequencies up to 30MHz (10 metres). The device provides high gain, low noise and an excellent AGC characteristic. It is encapsulated in a 16 pin quad-in-line plastic case, the outline of which is shown in Fig. 1. IC's of this

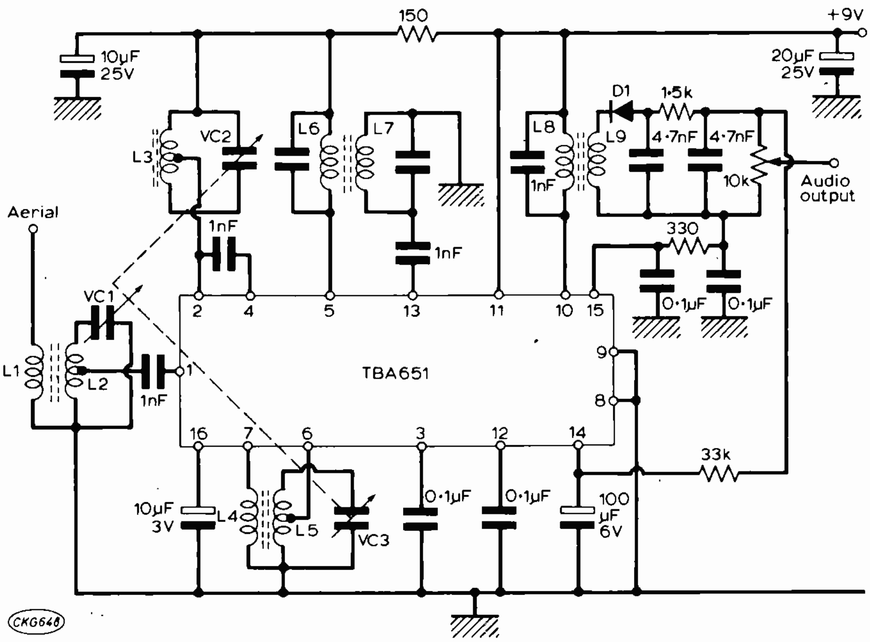

Fig. 2. Suggested circuit for a radio receiver designed around the TBA651. A capacitor, about 0·1μF, must be used to couple the audio output to the audio amplifier as DC is present at the output. A ferrite rod aerial may replace L1 and L2. Permeability tuning could be used in car radio applications.

type have alternate pins on each side of the body bent so that their ends form four lines (as shown in the end view). Sockets for these devices are not readily available and it is generally more convenient to solder directly to the pins.

Circuit

A typical circuit using the TBA651 is shown in Fig. 2. It includes a diode detector D1, which can feed an audio amplifier consisting of either discrete components or another integrated circuit.

The aerial signal is coupled to the input of the RF stage at pin 1 by means of L1 and the tuned circuit L2/VC1. The output signal from the RF amplifier appears at pin 2 across the tuned circuit L3/VC2. The two tuned circuits provide good image signal rejection. The capacitor connected to pin 3 provides AGC decoupling.

A signal taken from the tapping on L3 is fed to the mixer input, pin 4. The local oscillator tuned circuit is connected to pin 6 and the feedback winding to pin 7. The three variable capacitors VC1, VC2 and VC3 are ganged together and form the tuning capacitor.

The output from the mixer stage at pin 5 appears across the tuned circuit containing L6 and then coupled into the second IF tuned circuit containing L7, then feeding into the IF amplifier input stage at pin 13. The IF output appears at pin 10 across the tuned circuit containing L8. It is coupled to the untuned circuit containing L9 and detected by D1. It is filtered by the two 4·7nF capacitors and the 1·5kΩ resistor to remove the IF signal before being passed to the volume control and hence to the output.

It is important to note that the audio output from the volume control contains a steady voltage in addition to the audio signal. The output must therefore be capacitively coupled to the audio amplifier. A 0·1μF capacitor may be used.

Power supply

The TBA651 can be operated from a power supply voltage as low as 4·5V. The normal maximum operating voltage is about 16V but the device may be damaged if the absolute maximum permissible voltage of 18V is exceeded. The device requires about 12mA from a 12V supply, but much less at lower supply voltages.

Improvements

The simple circuit of Fig. 2 contains only three IF tuned circuits. The performance may be improved by the use of a more complex filter between pins 5 and 13, consisting of a number of tuned circuits resonant at the IF. However, it is generally more convenient to use one of the ceramic filters which are available. For example, the Toko filters contain an input and output tuned circuit coupled by a resonant ceramic disc. Such filters can provide a selectivity curve with the desirable flat top for good quality reproduction and the very steep skirts desirable for good adjacent channel selectivity. Nevertheless, ordinary tuned circuits are also required to provide good selectivity at frequencies away from the desired signal.

Filters of this type may have a pass band at least 6kHz wide (within the −6dB limits) and a response over 26dB down at 10kHz on each side of the centre frequency.

Performance

The gain of the RF mixer and IF stages are respectively about 20dB, 40dB and 60dB without AGC, but the losses associated with the tuned circuits must be subtracted from these values.

Fig. 3 shows how the output voltage from the receiver varies with the input level. The upper curve is for a 1·6MHz signal modulated at 30% at 1kHz, whilst the lower curve is the noise output when an unmodulated signal is fed to the input. It can be seen from the upper curve that the AGC action results in the audio output increasing from 0·5V at 20μV input level to only 1V at about 0·5V input. AGC is applied to the RF and mixer stages.

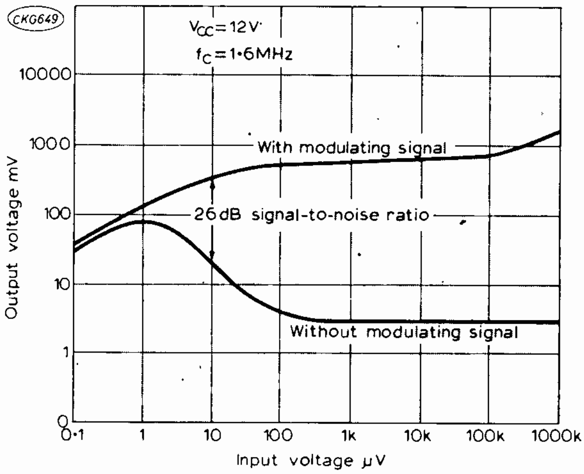

Fig. 3. Graph demonstrating the AGC characteristic of the TBA651.

The vertical distance between the two curves is a measure of the signal-to-noise ratio at the input level concerned. The high gain of the RF stage is largely responsible for the good signal-to-noise ratio even at low input signal voltages. The AGC applied to the RF stage is delayed until the input voltage exceeds a certain level so that the gain of the RF stage is a maximum at low input voltages thus providing a maximum signal-to-noise ratio. The amount by which the AGC is delayed can be reduced by connecting a resistor between pins 3 and 15 or increased by connecting a resistor between pins 3 and 14.

The TBA651 is a well-known device which is equally useful to the equipment manufacturer and to the amateur experimenter. Although no band switching is shown in Fig. 2, this circuit is suitable for use from the long wave band up to the highest short wave frequency used for long distance communication.

The TBA651 is available from Ambit International Ltd., 37 High Street, Brentwood, Essex, CM14 4RH at about £1·82 at the time of writing. This company also stocks Toko ceramic filters suitable for use with the IC.

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PART 2

A. FOORD

Typical Driver-output Circuits

In Fig. 12 a current source is used to drive the output transistors. A voltage gain can be provided in the output stages, which is an advantage in reducing the swing demanded from the previous stage. Another possible arrangement is shown in Fig. 13. Since this output stage has a unity gain this does give good thermal stability, but demands a high output swing from the previous circuit. Although integrated circuits are available for supplies of ±40V (such as the MC1536) their slew rate is inadequate and a completely discrete pre-driver stage is essential.

This circuit can be modified for a small gain

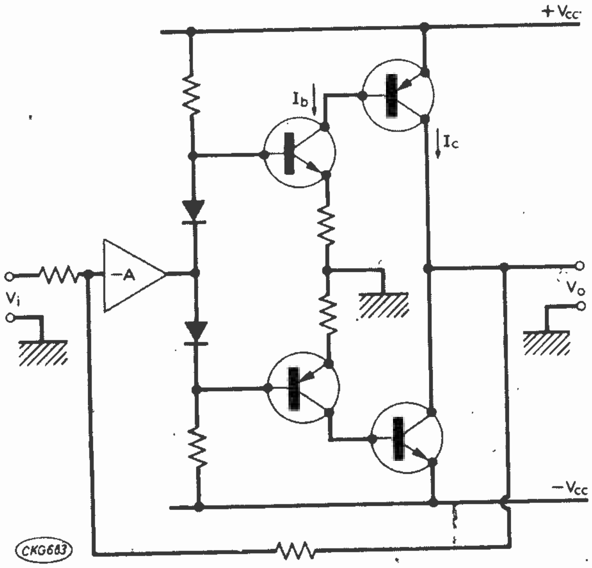


Fig. 12: A fully complementary driver-output circuit, using current drive for the output transistors.

(perhaps 5 times), as in Fig. 14, but the thermal stability is reduced and care must be taken in designing the DC conditions. However this basic configuration is very popular, and several variations are found in practical circuits. It has been shown that if Z_1 is inductive this can increase crossover switching spikes, but if made capacitive may reduce switching spikes. In some designs a capacitor in the order of $0\cdot1\mu F$ may be connected across Z_1. In addition a capacitor in the order of 1000pF may be connected across R3 to control the frequency response of the output stage.

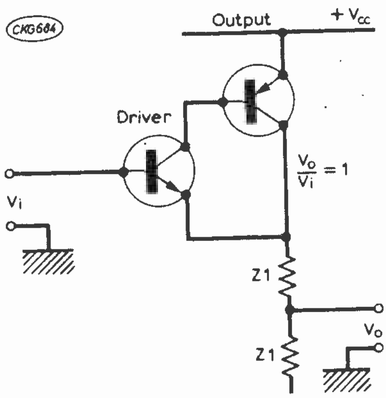


Fig. 13: One half of a unity gain driver-output circuit, using current drive for the output transistor.

Complete Circuit

To illustrate this article the circuit of Fig. 15 was constructed. The required voltage gain is provided by the integrated circuit, supplemented by the output stage, while the current gain is given by the class B output stage. The BC109 small signal transistor allows the potentiometer to set the quiescent current. There is 100% overall negative feedback at DC to maintain the output close to earth potential under no signal conditions, and direct coupling to the load allows a good LF response without using a large coupling capacitor.

For this amplifier graphs of distortion against output power level are shown in Fig. 16. For a 1kHz signal the distortion is below 0·02% for all power levels up to 4 watts, and rises to 0·1% at 30 watts.

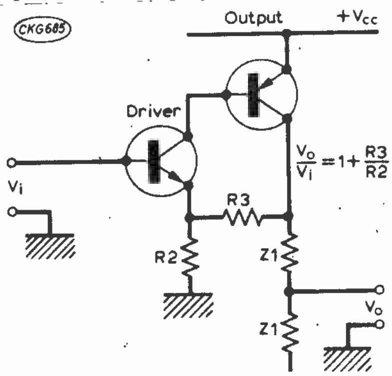
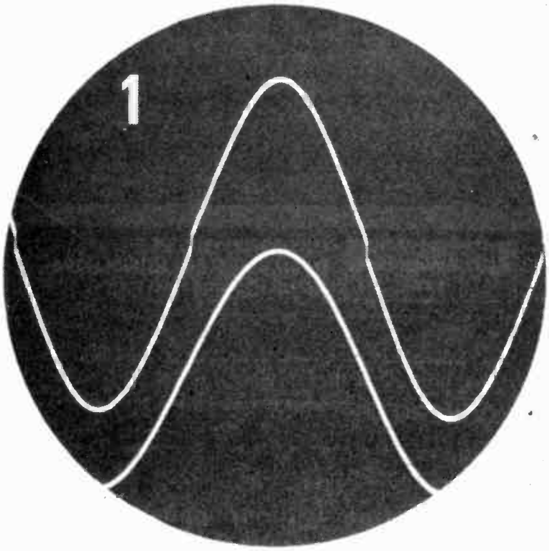


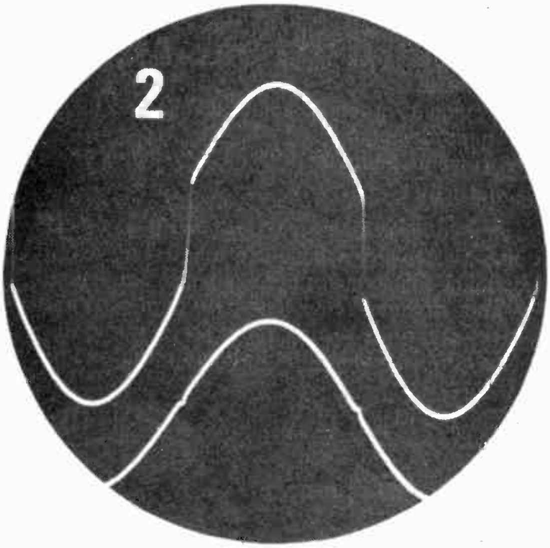
Fig. 14: One half of a driver-output circuit which gives a small voltage gain.

The 741 integrated circuit has a gain of 60dB at 1kHz, falling to 40dB at 10kHz, a factor of 10. This is manifest in the distortion measurements at 10kHz, where the levels are approximately ten times that of the 1kHz measurements. This illustrates the importance of maintaining a high loop gain throughout the audio band.

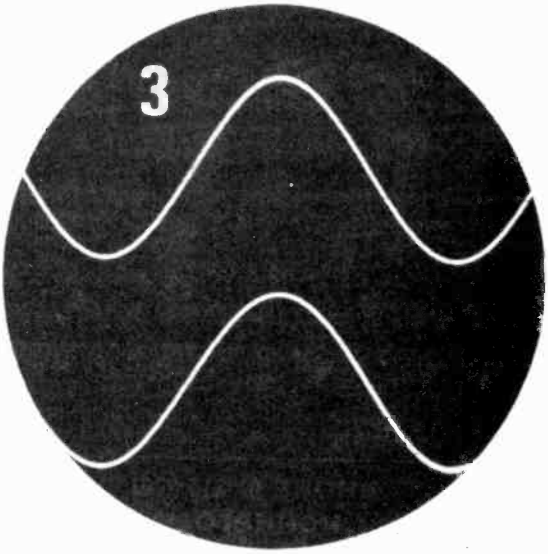
The photographs show the results on the basic amplifier under various circuit conditions.



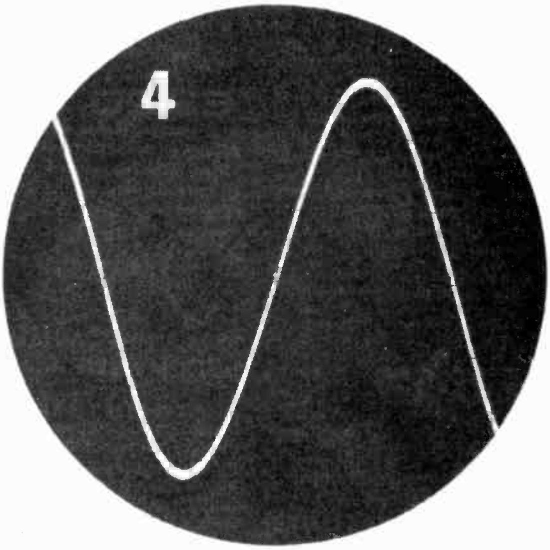
Photograph 1 Here the output power level is 5 watts with no quiescent current in the output transistors. The upper trace shows the output of the integrated circuit (pin 6), while the lower trace shows the power amplifier output. The overall feedback is inadequate to completely reduce the crossover distortion.



Photograph 2 Here the output power level is 100mW, with no quiescent current for the output transistors. This clearly shows the 0·3 volts step at the integrated circuit output as the loop gain attempts to 'force' the output stage through the non-linear region.



Photograph 3 Here the output power level is 100mW, with 20mA quiescent current for the output transistors. Neither the integrated circuit output nor the power amplifier output show any trace of crossover distortion.



Photograph 4 This shows the output of the power amplifier for an output level of 50μW. Even at this very low level there is no trace of crossover distortion.

For photographs 1, 2 and 3 the oscilloscope sensitivity for the integrated circuit output (upper trace) was five times that for the power amplifier output (lower trace).

Power Integrated Circuits

Several of the more recently available integrated or hybrid circuits are capable of delivering large currents not normally associated with conventional operational amplifiers. The National Semiconductor LH0021 series, for example, is supplied in an 8 pin TO-3 package rated at 20 watts with a suitable heat

—*continued on page 225*

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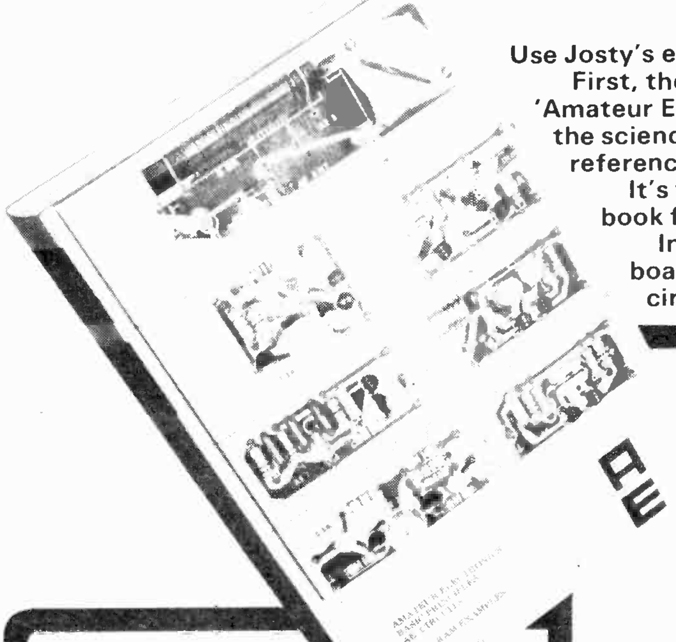

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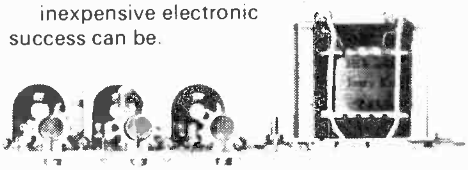

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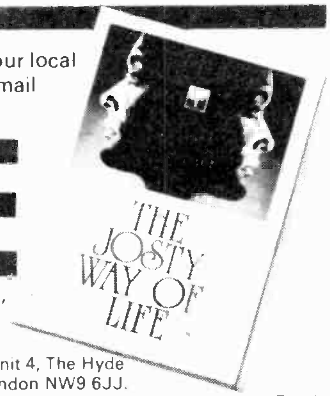

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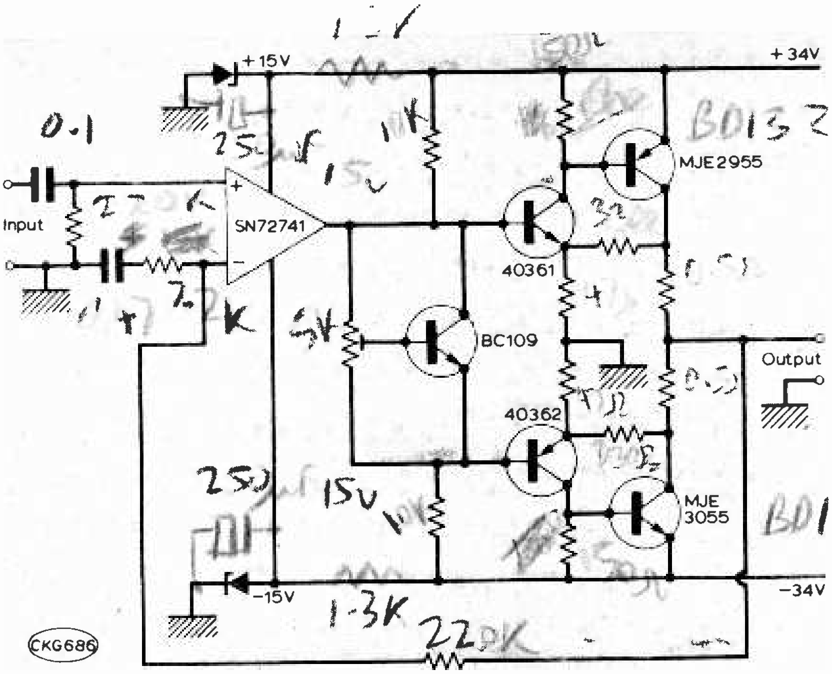

X 30
IN 600mV
300mV

Fig. 15: A basic 30W power amplifier.

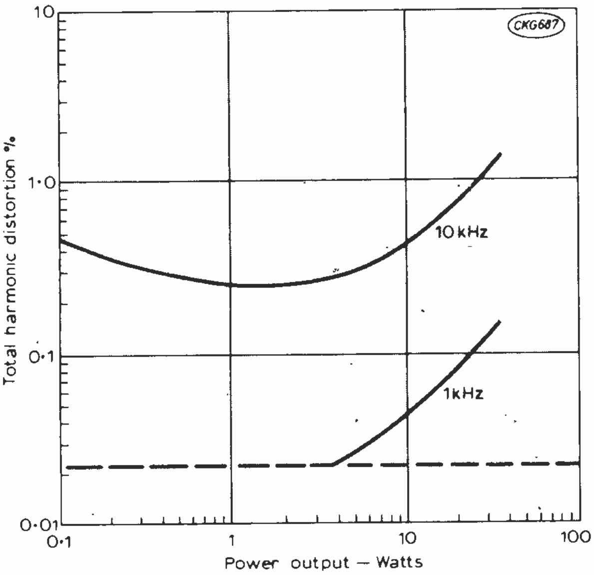

Fig. 16: Total harmonic distortion measurements for the amplifier of Fig. 15.

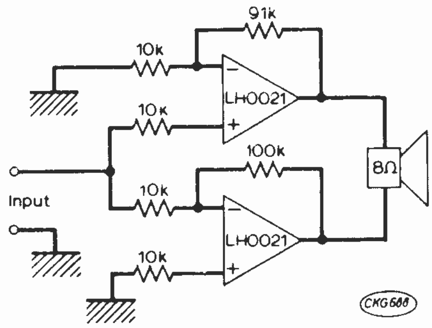

Fig. 17: A 35W power amplifier using a push-pull output stage.

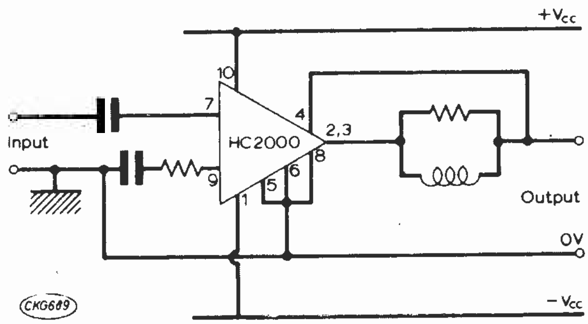

Fig. 18: A 100W hybrid power amplifier.

—continued from page 222

sink. This operational amplifier is suitable for DC servomechanisms, programmable power supplies, etc. Fig. 17 shows a 35 watts audio amplifier using two in a push-pull configuration. Similarly the RCA-HC2000 power hybrid operational amplifier can deliver 100 watts into a 4 ohm load, as shown in Fig. 18.

Conclusions

The reduction in β, the 0·6V Vbe for each output transistor, and the other effects discussed here can cause an increase in distortion at low and high signal levels. However the problems associated with distortion in power amplifiers can be solved, at a price. Certainly the best amplifiers are limited in performance by the remainder of the Hi-Fi system, the loudspeaker, microphone, tape recorder, pickup, etc., and the necessity for further distortion reduction in power amplifiers may be challenged. However there is a good case for increased power output in power amplifiers, since loudspeaker efficiency decreases with fidelity, and high power may be demanded to drive the very best loudspeakers on transients. Efficiency may be typically 0·5%. At such power levels speaker and amplifier unit protection is essential, but that is another problem. ■

Dear Sir,

letters

Test Gear

I congratulate you on your decision to start a series of constructional projects on test equipment. It's a pleasant change from the unending series of amplifiers of astronomical output and ever-increasing perfection that so many amateur constructional magazines publish.

Personally, I started taking "P.W." regularly in the hope that something which could be adapted for use in instruments would come up, so your series is very timely. In particular, a simple wobbulator to cover 465kHz and 10·7MHz for lining up I.F.s on a scope, a transistor voltmeter of enormous input impedence, a gadget for tracing valve/transistor characteristics on a 'scope (which according to Mr. Scroggie can be done, but which may be too complicated) and a transistorised beam-splitting switch (as currently advertised by Chiltmead) are what I'd like.

I do, of course, totally disagree with your remarks about test equipment being uninteresting and wish you good luck in this new line.—**R. G. Roberts** *(Herts)*

Weaned on transistors?

It was with great interest that I read your "Going Back" article about the History of *Practical Wireless*. Might it be possible, however, to reprint some of your articles from these earlier issues to show these transistor weaned people what proper electronics is all about?!

I have written before on this subject, and there seemed to be some success for several months but then the valve disappeared again. As one of the multitude who delight in the thermionic glow, I would like to hear what other readers think on the subject!—**T. G. Watton** *(Kingston upon Hull.*

Surplus Gear

In your "C Q" feature, there are numerous queries for information on Government Surplus Equipment. I feel it would be of assistane to the interested parties, to obtain the book on the subject, called "Govt. Surplus Wireless Equipment Handbook."

I have no connection with the publisher, but have recently purchased one from Gerald Myers, 18 Shaftesbury St., Leeds LS12 3BT.—**K. F. Tunnicliffe** *(Leics)*.

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0·068; 0·082; 0·1 ea. **4p**

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Code	*Watts*	*Ohms*	*1 to 9*	*10 to 99* (see note below)	*100 up*	
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C	1/2	4·7–10M	1·3	1·1	0·9	nett
C	3/4	4·7–10M	1·5	1·2	0·9	nett
C	1	4·7–10M	3·2	2·5	1·9	nett
MO	1/2	10–1M	4	3·3	2·3	nett
WW	1	0·22–3·9	9	9	8	
WW	3	1–10K	7	7	6	
WW	7	1–10K	9	9	8	

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1·0	—	—	—	—	—	11p	—	8p
2·2	—	—	—	—	11p	—	8p	9p
4·7	—	—	—	11p	—	8p	9p	8p
10	—	—	—	—	8p	9p	8p	8p
22	—	—	8p	—	8p	8p	8p	10p
47	8p	—	9p	8p	9p	8p	10p	13p
100	9p	8p	8p	8p	9p	10p	12p	19p
220	8p	8p	9p	10p	10p	11p	17p	28p
470	9p	10p	10p	11p	13p	17p	24p	45p
1,000	11p	13p	13p	17p	20p	25p	41p	—
2,200	15p	18p	23p	26p	37p	41p	—	—
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149	60	3	12	9·9 x 7·7 x 8·6	3·79	36
150	100	5	8	9·9 x 8·9 x 8·6	4·17	52
151	200	8	0	12·1 x 9·3 x 10·2	7·09	52
152	250	13	12	12·1 x 11·8 x 10·2	9·25	67
153	350	15	0	14·0 x 10·8 x 11·8	12·32	82
154	500	19	8	14·0 x 13·4 x 11·8	17·87	–
155	750	29	0	17·2 x 14·0 x 14·0	24·31	
156	1000	38	0	17·2 x 16·6 x 14·0	29·87	–
158	2000	60	0	21·6 x 15·3 x 18·1	49·25	–

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64	75	2	4	7·4 x 6·7 x 6·1	0-115-210-240	2·64	30
4	150	3	4	8·9 x 7·7 x 7·7	0-115-200-220-240	3·18	36
66	300	6	4	9·9 x 9·6 x 8·6	"	6·19	52
67	500	12	8	12·1 x 11·2 x 10·2	" "	9·20	67
84	1000	19	8	14·0 x 13·4 x 14·3	" "	16·71	82
93	1500	30	4	14·0 x 15·9 x 14·3	" "	24·19	–
95	2000	32	0	17·2 x 16·6 x 14·0	" "	31·57	•
73	3000	40	0	21·6 x 13·4 x 18·1	" "	39·17	•

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213	1·0	0·5	1	4	6·1 x 5·8 x 4·8	0-12V at 0·5A x 2	1·58	22
71	2	1	1	12	7·0 x 6·4 x 6·1	0-12V at 1A x 2	2·09	22
18	4	2	2	12	8·3 x 7·7 x 7·0	0-12V at 2A x 2	2·95	30
70	6	3	3	8	8·9 x 8·0 x 7·7	0-12V at 3A x 2	3·52	42
108	8	4	5	8	9·9 x 8·9 x 8·6	0-12V at 4A x 2	3·96	52
72	10	5	6	4	9·9 x 9·6 x 8·6	0-12V at 5A x 2	4·67	52
116	12	6	6	12	9·9 x 10·2 x 8·6	0-12V at 5A x 2	5·61	52
17	16	8	8	12	12·1 x 9·9 x 10·2	0-12V at 8A x 2	7·22	52
115	20	10	11	8	14·0 x 9·6 x 11·8	0-12V at 10A x 2	9·20	67
187	30	15	15	8	14·0 x 12·1 x 11·8	0-12V at 15A x 2	16·94	82
226	60	30	32	0	17·2 x 15·3 x 14·0	0-12V at 30A x 2	31·28	•

30 VOLT RANGE

Ref. No.	Amps.	Weight lb	oz	Size cm.	Secondary Taps	P & P £	p
112	0·5	1	4	6·1 x 5·8 x 4·8	0-12-15-20-24-30V	1·56	22
79	1·0	2	4	7·0 x 6·7 x 6·1	" "	2·11	36
3	2·0	3	4	8·9 x 7·7 x 7·7	" "	3·18	36
20	3·0	4	8	9·9 x 8·3 x 8·6	" "	3·96	42
21	4·0	6	4	9·9 x 9·6 x 8·6	" "	4·67	52
51	5·0	6	12	12·1 x 8·6 x 10·2	" "	5·83	52
117	6·0	8	0	12·1 x 9·3 x 10·2	" "	6·94	52
88	8·0	12	0	12·1 x 11·8 x 10·2	" "	9·00	67
89	10·0	13	12	14·0 x 10·2 x 11·8	" "	11·36	67

50 VOLT RANGE

Ref. No.	Amps.	Weight lb	oz	Size cm.	Secondary Taps	P & P £	p
102	0·5	1	12	7·0 x 6·4 x 6·1	0-19-25-33-40-50V	2·09	30
103	1·0	2	12	8·3 x 7·4 x 7·0	" "	3·08	36
104	2·0	5	8	9·9 x 8·9 x 8·6	" "	4·26	42
105	3·0	6	12	9·9 x 10·2 x 8·6	" "	5·79	52
106	4·0	10	0	12·1 x 10·5 x 10·2	" "	7·69	52
107	6·0	12	0	14·0 x 10·2 x 11·8	" "	11·38	67
118	8·0	18	0	14·0 x 12·7 x 11·8	" "	12·40	97
119	10·0	25	0	17·2 x 12·7 x 14·0	" "	18·62	•

60 VOLT RANGE

Ref. No.	Amps.	Weight lb	oz	Size cm.	Secondary Taps	P & P £	p
124	0·5	2	4	7·0 x 6·7 x 6·1	0-24-30-40-48-60	2·12	36
126	1·0	3	4	8·9 x 7·7 x 7·7	" "	2·97	36
127	2·0	6	4	9·9 x 9·6 x 8·6	" "	4·67	42
125	3·0	8	12	12·1 x 9·9 x 10·2	" "	7·11	52
123	4·0	13	12	12·1 x 11·8 x 10·2	" "	9·20	67
40	5·0	12	00	14·0 x 10·2 x 11·8	" "	10·83	87
120	6·0	15	8	14·0 x 12·1 x 11·8	" "	13·35	82
121	8·0	25	00	14·0 x 14·7 x 11·8	" "	15·01	•
122	10·0	25	0	17·2 x 12·7 x 14·0	" "	22·10	•
189	12·0	29	00	17·2 x 14·0 x 14·0	" "	24·74	•

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Ref.	MA.	Weight		Size cm	VOLTS	P & P £	p
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212	1A 1A	1	4	6·1x5·8x4·8	0-6 0-6	1·67	22
13	100		4	3·9x2·6x2·9	9-0-9	1·23	10
235	330,330		4	4·8x2·9x3·5	0-9, 0-9	1·67	10
207	500, 500	1	00	6·1x5·4x4·8	0-8-9, 0-8-9	2·23	22
208	1A, 1A	1	12	7·0x6·4x6·1	0-8-9,0-8-9	3·00	30
236	200, 200		4	4·8x2·9x3·5	0-15, 0-15	1·67	10
214	300, 300	1	4	6·1x5·8x4·8	0-20, 0-20	1·76	22
221	700 (D.C.)	1	8	7·0x6·1x6·1	20-12-0-12-20	1·55	30
206	1A, 1A	2	12	8·3x7·7x7·0	0-15-20, 0-15-20	4·05	36
203	500, 500	2	4	8·3x7·0x7·0	0-15-27, 0-15-27	3·10	38
204	1A, 1A	3	4	8·9x7·7x7·7	0-15-27, 0-15-27	3·15	38

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PART 9—POTENTIAL DIVIDER BIASING & GROUNDED BASE AMPLIFIERS

(continued from the June issue)

We now move away to a different type of amplifier stage; the *grounded base stage*. The basic circuit is shown in Fig. 65. In many respects it looks similar to that we have just described but it has considerable differences. Signal input is at point A (at the emitter) for a start. This circuit has very low input impedance and quite a high output impedance; it provides us with a very useful voltage amplification but no current gain. It is used when we have a signal source that has low resistance and very low output voltage (e.g. low impedance microphones or some guitar pick-ups). Unlike the grounded emitter stage there is no change of phase between input and output.

The resistors R3 and R4 provide a fixed bias so you can assume that the transistor is conducting on a linear portion of its characteristic and there will be a collector current flowing (ideally just sufficient to give us a mid rail output at the collector).

This collector current merges with base current within the transistor and emerges as emitter current. Most of the emitter current is made up of the original collector current. If we change the emitter current (by the application of an external signal at point A) we will—indirectly—alter the collector current. Because R2 is of small value it does not need much in the way of voltage at A to create reasonable changes in current flowing through R2 (but, of course, the source of current must also have a low resistance). These changes in emitter current are converted, by the transistor, to similar changes in collector current flowing through R1 but as R1 has a high resistive value we will get much larger voltage changes across it than we applied to R2—hence voltage amplification. This is a very over-simplified explanation but we hope it conveys the operating method of the circuit without having to resort to complicated mathematics.

We can arrive at component values by using a similar technique to that adopted for the grounded emitter stage. The main difference is that we want to keep the quiescent potential at A as low as possible—so that the voltages that generate our input

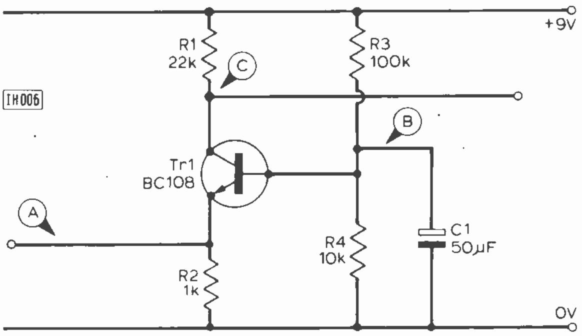

Fig. 65: Basic circuit of a grounded base stage.

current are significant. In this case we have based our component calculations on the assumption that the potential at A is to be approximately 200mV. This means that the potential at B will be +800mV. It is essential that the base current we supply to the transistor is highly stable and as the bias chain is not going to create input impedance problems in this case we can arrange for a much higher standing current to flow through R3 and R4. To prevent the base potential being affected by signals we swamp any changes there might be with the large capacitor C1. Make up the circuit for Fig. 65 and measure the respective potentials and then go on to experiment with the working circuit of Fig. 66. The input signal should come from a very low impedance source but at the same time should be decoupled from the emitter of the grounded base stage as far as d.c. is concerned (C1) otherwise we would alter our quiescent working point. We suggest an old miniature loudspeaker (any impedance from 3 to 35 ohms will do) as a microphone but you could use an ex Post Office telephone earpiece as a rough and ready microphone. Alternatively you could make up a crude form of guitar pick-up by winding about 100 turns of fine enamelled copper wire on an Eclipse button magnet. As soon as a

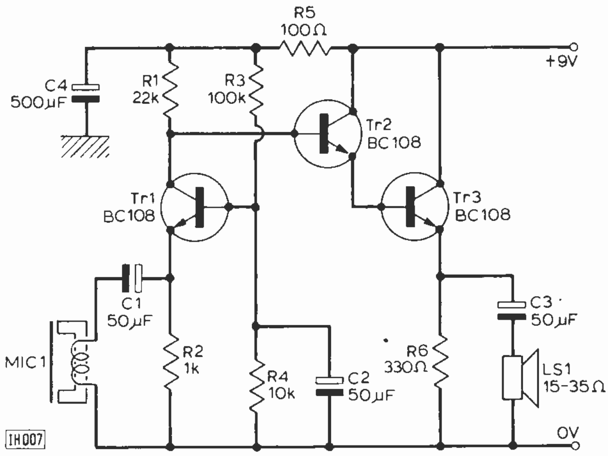

Fig. 66: Using a grounded base stage to amplify a signal from a low impedence source. MIC 1 could be a 35Ω loudspeaker, a moving armature earpiece (or P.O. telephone earpiece) or a variable reluctance transducer—see Fig. 70.

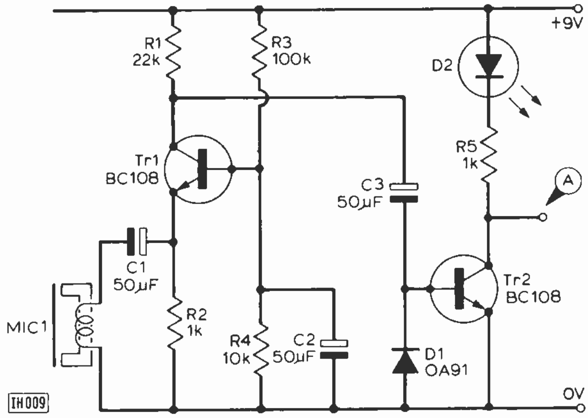

Fig. 68: Changes in flux in the variable reluctance transducer cause the LED (D2) to flash. Simultaneously the potential at A drops in negative going spikes.

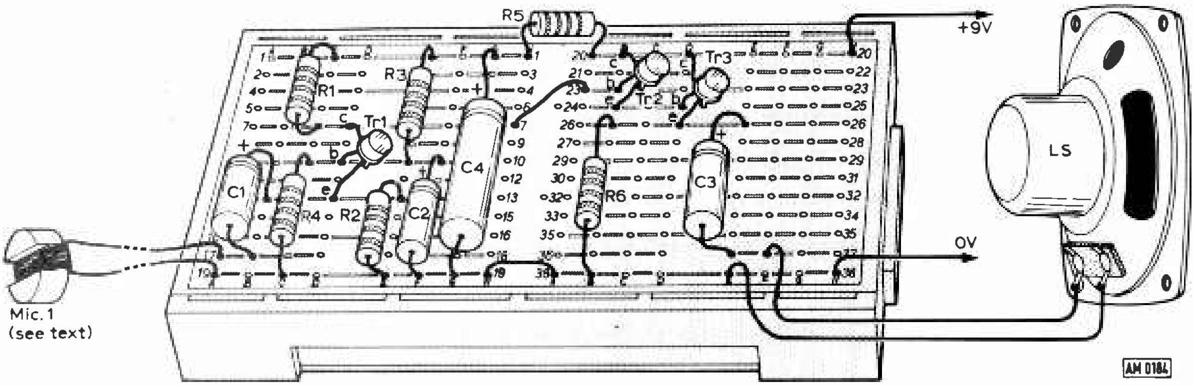

Fig. 67: Layout for Fig. 66.

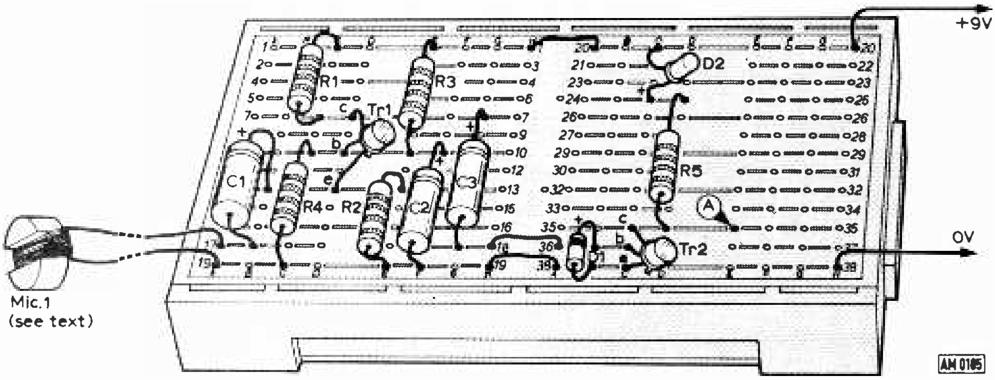

Fig. 69: Layout for Fig. 68.

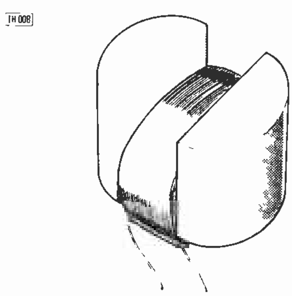

Fig. 70: A variable reluctance transducer can be made by winding about 100 turns of 36 s.w.g. enamelled wire around the base of an Eclipse button magnet. This type of transducer could be used as a simple guitar pickup—provided steel strings are used.

piece of ferromagnetic material touches the magnet you should hear a loud "clunk" from the amplifier. A steel string vibrating between the poles will vary the reluctance of the magnetic circuit at the frequency of the string and this would give rise to a low a.c. output voltage from the transducer.

By modifying the circuit to that of Fig. 68 you can make the light emitting diode flash whenever a piece of iron, or steel, comes in contact with the transducer. Any low power LED will do for D2 but please take note of the connection polarity!

next month—Loudspeaker Drivers.

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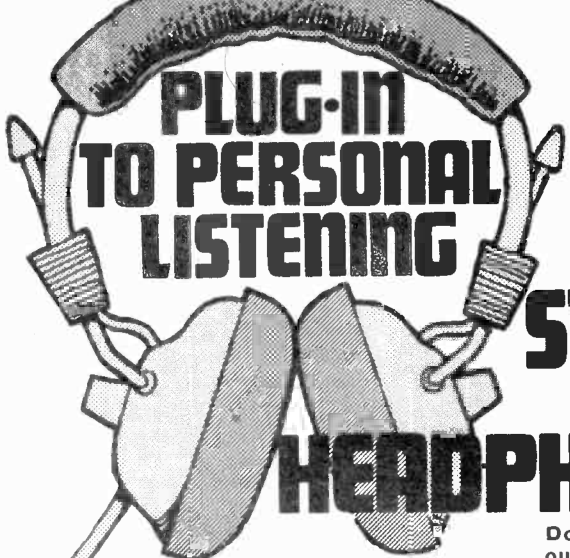

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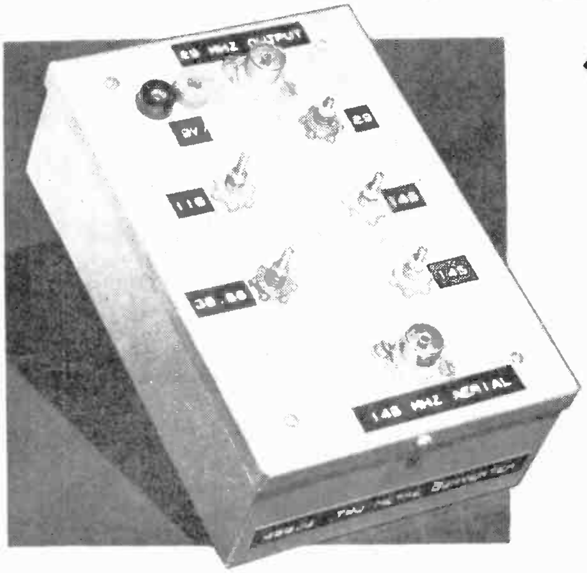

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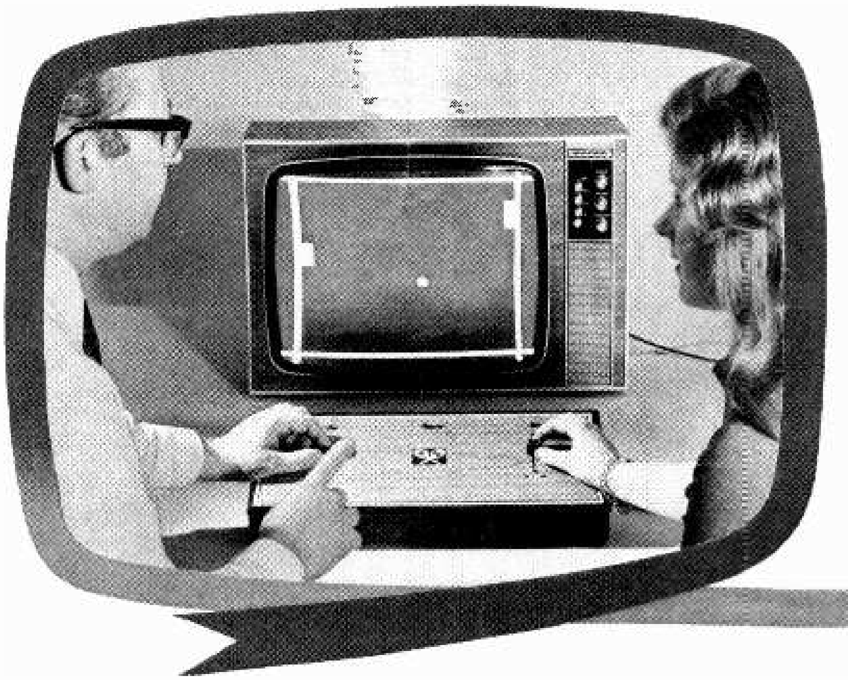

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PLAYED ON THE TELEV

PART 1

IT seems an awful waste that the most sophisticated electronic instrument most houses boast should be used only to watch Bugs Bunny or Coronation Street. Already the broadcasting authorities are considering the domestic television set as the basis for a data display terminal in the proposed Oracle and Ceefax systems. Why should we not use the same equipment for exciting new indoor games, puzzles and competitions? This series describes how you can make your own version of a game that is sweeping pubs and clubs throughout America and is rapidly being introduced over here.

The game is "Television Tennis", it involves skill and coordination, can be played by two people and provides excitement which can be shared by young and old. A word of warning to the proud; the author's 6 year old son can hold his own against most competition when playing the game, so there is plenty of challenge for the adult! It is an ideal indoor pastime for rainy days, but many private clubs or social societies might find benefit to their funds in building one of these fascinating, but addictive games.

Once built, the game is simplicity to install; only two connections are required—one to a mains socket and the other via a coaxial lead to the aerial socket of a domestic television. No alterations are needed to the TV except to tune in to a fourth channel and the set can be used normally at any time. Either a colour or black and white set can be used; the only limitation is that it must be a UK standard UHF 625 line model.

Before embarking on the original design the author had some misgivings about the potential complexity of the project and whether it would be suitable for the amateur constructor. By careful design and the use of integrated circuits and printed circuit boards there is no reason why it could not be undertaken by anyone with reasonable soldering ability. The cost of the project might be a bit high for some people—nevertheless it works out much less than a medium quality stereo amplifier. We are giving a complete list of components in this first part so that you may judge the likely cost for yourself before embarking on the project.

Those who decide to go ahead can make use of this list to obtain best prices for quantity purchases. All the components are now commonplace devices but, as many readers will know, there is a general shortage of components and you may expect delays in delivery of some of the integrated circuits.

In this issue we will describe the general principles of the instrument. Subsequent parts will carry construction details for each of the six circuit boards used, starting with the power supply and UHF modulator. The constructor will then be able to use his domestic TV set as a setting-up instrument for the remaining circuitry thus obviating the need for an oscilloscope.

Presentation

For those who have not yet seen the commercial version—now becoming fairly standard in most amusement arcades—Fig. 1 shows the appearance

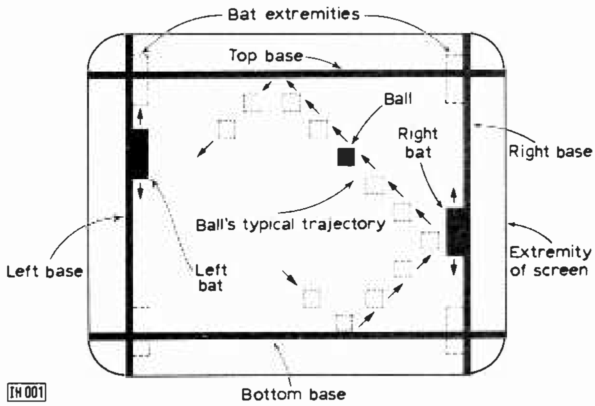
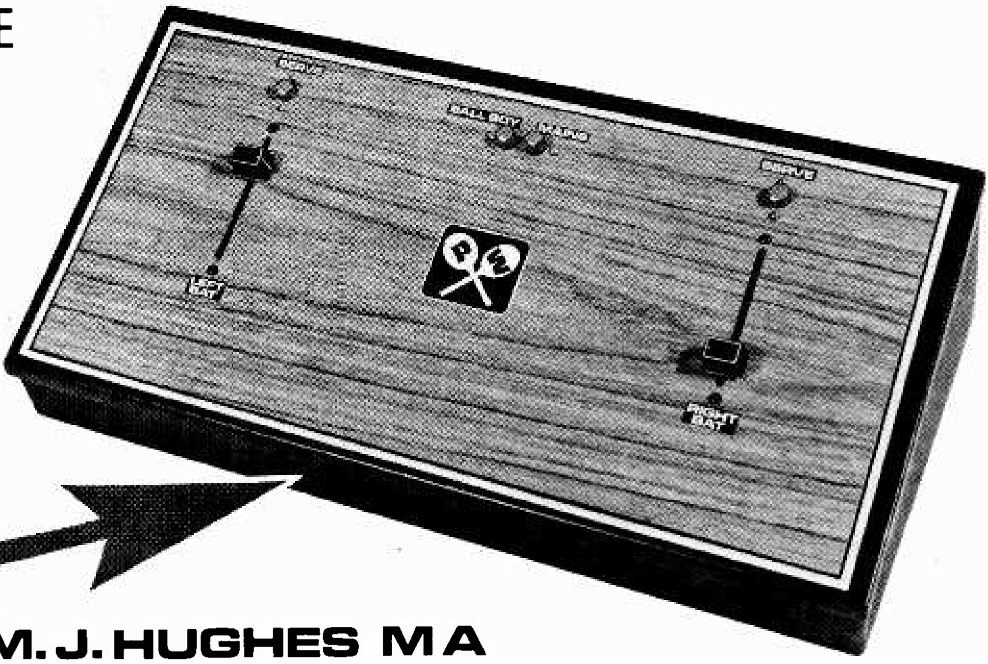


Fig. 1: Appearance of the game identifying the various parts of the display.

ECTRONIC GAME

ISION SCREEN



M. J. HUGHES MA

of the game. The television screen displays a representation of a tennis court bounded by two horizontal and two vertical base lines; these are designated the top, bottom, left and right bases. A short vertical bar occurs on the inside surfaces of the left and right bases; these bars represent the players' racquets or bats and their vertical positions along the base lines are controlled by two slider potentiometers on the front panel of the game. Each player can thus control the position of his own bat. To start a game, one of the players presses his "service" button and a ball (small square) will appear out of his base line and move rapidly across the screen towards his opponent. The ball takes an oblique path and, as there is no telling from what point on the base line it will start, it might head straight for the top or bottom base. If the ball hits either of these bases it "bounces" back into the court just like a billiard ball off a cushion. If the opponent positions his bat so that the ball eventually hits it the ball rebounds towards the first player—and so the game progresses. If, however, one of the players misses the ball it will hit the left or right base and disappear until the next service.

No sound effects have been built in, but two signals are provided which could be used to make a "clack" whenever the ball hits either of the bats. This would require extra circuitry which was felt to be rather a luxury and was therefore omitted from the prototype.

TV picture principles

To appreciate how the system works it is essential to understand how a picture is built up on a television screen and to note one or two features of a television raster.

A raster is the regular set of lines which appear on the face of the television tube—whether or not any picture is being displayed. It comprises approximately 625 lines going from left to right on a modern UK standard set. We say approximately because some of the lines are not seen—occurring above the top of the picture. Referring to Fig. 2, the lines are made by a spot which starts scanning across the top of the tube from left to right. When it reaches the right hand side, the time taken being $64\mu S$, it returns very rapidly to the left side (this is called the line fly back), steps down the screen a short way and repeats its left to right scan. This periodic scan continues for 1/50 of a second (20mS) and each time a new line is drawn.

At the end of 20mS you can calulate that with a line frequency of 15·625kHz there will be $312\frac{1}{2}$ horizontal lines drawn at successive vertical positions across the screen forming one field. In a normal television signal the spot then flies back to the top left hand corner (this is called the field fly-back) to a position in between the original scanned lines and repeats the operation. This technique is known as interlaced scanning and the 625 line picture, with which we are all familiar, is actually made up of two separate fields of $312\frac{1}{2}$ lines interlocking with each other. The effect of interlace is to give a very high resolution picture with an effective repetition rate of 25Hz.

Our system is NOT fully interlaced. The picture we display on the screen is generated complete on the $312\frac{1}{2}$ lines of one field. We repeat the field scan at a frequency of 50Hz so that in 1/25 of a second we still build up a total of 625 lines—although they do not necessarily interlace precisely. Resolution is not a problem in our application and the use of random interlace, as it is called, considerably simplifies design.

Summarising, we have a spot that moves from left to right every $64\mu S$ and from top to bottom in 20mS. Electronically we can identify the start of every 20mS field scan with an electronic pulse (a field sync pulse) and in a similar way we can "tag" the start of every line using a line sync pulse. In a single field there are $312\frac{1}{2}$ lines each of which starts scanning at a precise interval of time after the field sync pulse.

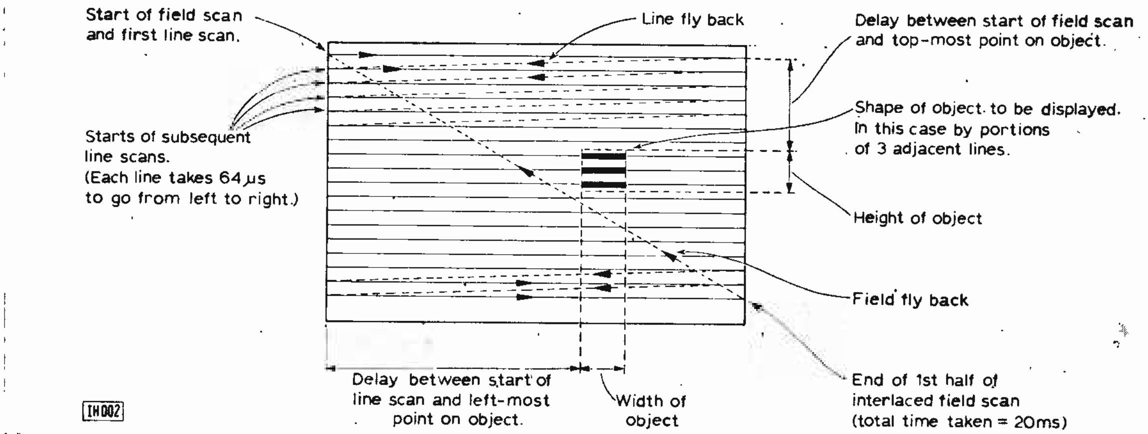


Fig. 2: Elements of a TV raster showing how an object's position can be represented by times within the field and line scans.

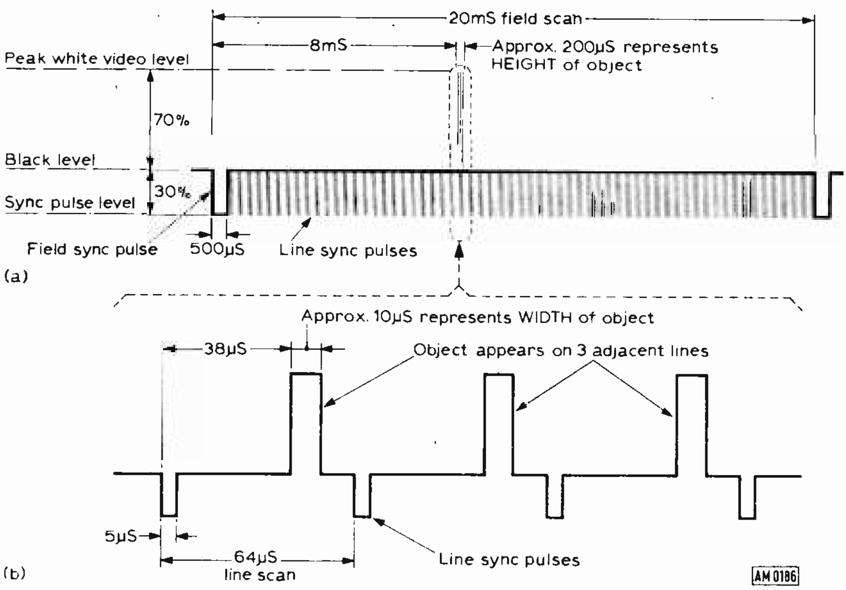


Fig. 3: The periodic waveform required to produce the object shown in Fig. 2.

Picture generation

Suppose, for example, we want to delineate a square block on the screen at a certain position as shown in Fig. 2. We can do this by specifying on which of the horizontal lines the block is to occur and how far along those lines the block should extend. This can be done by coordinating the block in terms of time from the start of the field (this specifies on which line the block starts to be delineated) and time from the start of the line in question. The width of the block is determined by the length of time we allow the spot to "Bright-Up" along the line and the height of it by the number of successive lines we allow to bright-up. This number of lines is equally determined by time.

The waveforms of Fig. 3 show the signals which would delineate the block shown in Fig. 2. We take +300mV as an arbitrary zero signal level, called black level; any signals going from +300mV in a negative direction are the sync pulses—mentioned earlier. For simplicity of circuitry, we generate a single field sync pulse rather than the train of pulses normally used in broadcast TV practice. In our case we make the field sync pulse 500µS long (Fig. 3a) and between it and the next we generate approximately 312 line sync pulses—each 5µS long (Fig. 3b). Positive going signals above +300mV are video levels; these control the brightness of the spot on the television tube. A standard of 700mV above black level is taken as peak white.

To produce the block of Fig. 2 we want to make use of three lines occurring about 8mS down the field. It takes 64 x 3 = 192µS for three adjacent lines to scan across the screen, so we can say that the height of the block is contained within a window of about 200µS occurring 8mS after the field sync. The horizontal position of the block is just to the right of screen centre, say 38µS after line sync. To give the required width the duration of the video signal on each of the three lines would, in this case, be 10µS. Thus you can see that the video signal we want occurs over a very small portion of the field waveform and equally over a very small portion of the three lines.

To generate the signal in the correct time position we need a number of time delay elements, controlled by the synchronisation pulses. One sets the vertical position while another sets the height relative to the field sync. A third sets the horizontal position

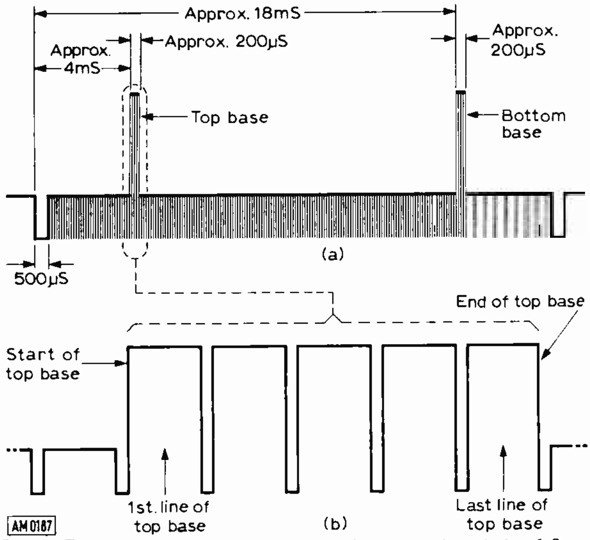


Fig. 4: The top and bottom baselines each occupy the whole of five line scans.

and a fourth the width. We take the field and line video waveforms so produced and combine them in an AND gate to give the video signal in its correctly coordinated time position.

It is a little difficult to grasp this at first because we are dealing in times as opposed to normal vertical and horizontal dimensions. Nevertheless, after a bit of thought, one can quickly get used to thinking of vertical and horizontal times as being equivalent to dimensions across the face of the screen. What we have just described is the technique for producing the video signal for the ball in our game. The position of the ball on the screen and its apparent movements are set by the time delays after the field and line sync pulses. These delays are generated by voltage controlled timing units.

The top and bottom base lines are somewhat simpler to produce because they extend the full width of the screen. We need only define the respective vertical positions and heights (number of lines to be brightened up). These waveforms are shown in Fig. 4. Similarly the left and right bases occur on every line so we need only define their coordinates in terms of time across the screen, Fig 5.

In practice we have to prevent video information appearing in our composite waveform during field and line synchronisation pulses. This is accomplished by means of blanking pulses which, for reasons of simplicity, are made the same length as the sync pulses. In other words the front and back porches normally present on line sync pulses are missing. We use conventional TTL logic levels of +5V and OV to generate and define all video and sync information and only in the last stage do we convert to normal television signal voltages. In the descriptions that follow a logical "1" or +5V denotes that a video signal is in the state that would bright-up the spot on our screen. To simplify descriptions we have adopted a crude form of Boolean Algebra terminology to describe our waveforms. For example if we use the term "BALL" we mean the waveform that, if fed to the screen, would display the ball—$\overline{\text{BALL}}$ is therefore the inverted waveform for the ball. Other terms that we use include LEFT BASE, $\overline{\text{LEFT BASE}}$, RIGHT BASE, $\overline{\text{RIGHT BASE}}$, LEFT BAT, $\overline{\text{LEFT BAT}}$ etc. We shall define other terms later.

★ overall components list

Resistors
1/8 or 1/4W, 5%:—

330Ω—6	1·8kΩ—2	15kΩ—5
470Ω—1	2·2kΩ—6	22kΩ—3
620Ω—4	3·9kΩ—1	27kΩ—2
1kΩ—10	4·7kΩ—16	68kΩ—1
1·2kΩ—4	12kΩ—1	100kΩ—3
12Ω 5W—1	68Ω 1W—1	
220Ω 1/2W—1		

Potentiometers
Linear Sliders:— 5kΩ—2
Submin presets, vertical mounting:—

5kΩ—1	25kΩ—3	250kΩ—2
10kΩ—1	100kΩ—3	1MΩ—2

Capacitors

Polystyrene:—		
1000pF—3	1500pF—4	2200pF—4
Polyester:—	0·1μF—15	0·47μF—1
	0·33μF—2	2·2μF—2
Electrolytic:—	47μF 25V—4	100μF 25V—1
1000μF 12V—1	2000μF 25V—2	3000μF 25V—1

Semiconductors

Diodes:—	1N914—24	1N4004—4
Transistors:—	BC108—2	
I.C.'s:—	7805 (regulator)—1	
NE555—12 10	LM741C—2	SN7400—16 £2

Miscellaneous
I.C. sockets:— 14-lead DIL—16, 8-lead DIL-14
Transformer:— Pri: 240V. Sec: 12/15V 0·5A
Switches:—Push-button type.
DPCO, non-locking—3
DP Push-ON/Push-OFF, 250 VAC rating—1
UHF Modulator kit by Crofton Electronics, 15/17 Cambridge Road, Kingston-upon-Thames, Surrey KT1 3NG
plus PCBs, cabinet, output socket, etc.

Notes
1. The PCBs are available to order from:—
R. Whittaker
57 Mungo Park Way
Orpington, Kent
at £7·50 per set of six boards including p.p. and VAT. The boards are fully drilled and are available by mail order only.
2. An undrilled cabinet in 16swg aluminium is available to order from:—
H. L. Smith & Co.
287 Edgware Road
London W.2
at £3·00 including p.p. and VAT.

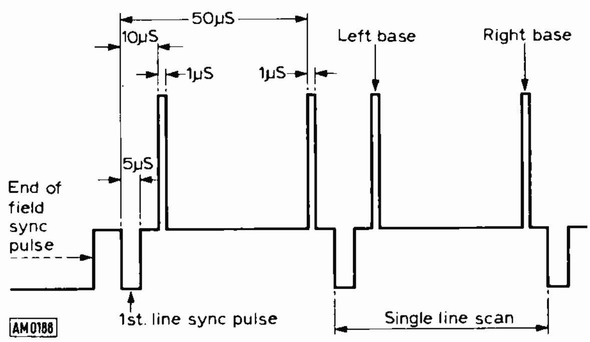


Fig. 5: The left and right base lines occur on every line of the field.

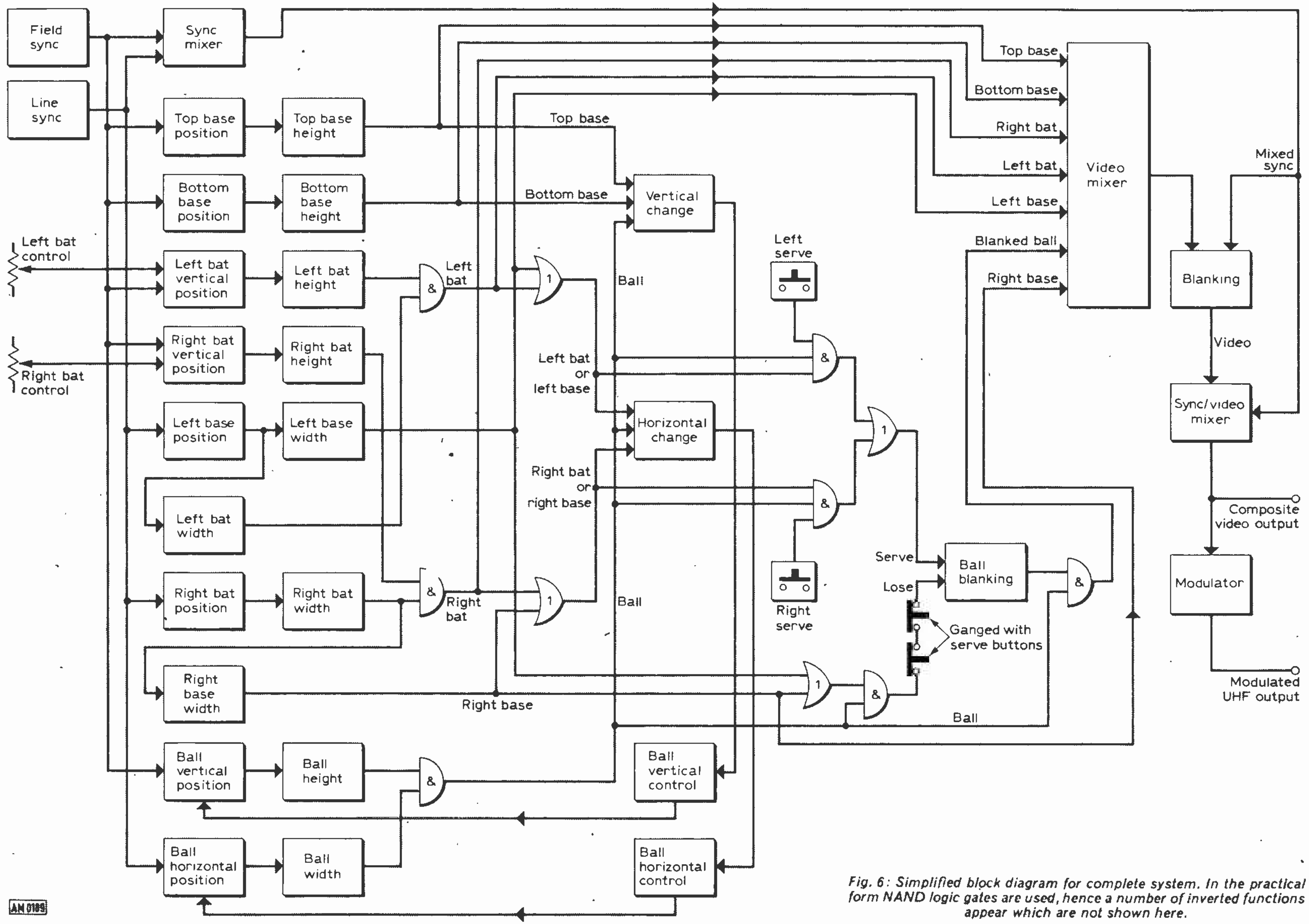


Fig. 6: Simplified block diagram for complete system. In the practical form NAND logic gates are used, hence a number of inverted functions appear which are not shown here.

System description

A simplified block diagram of the complete system is given in Fig. 6. Note that we show basic AND and OR functions in this diagram; in practice NAND gates are used and the logic connections are rather more involved. These will be dealt with in detail in subsequent parts. It is more important at this stage to try to understand the overall system.

All operations are linked to the field and line sync generators. These feed all the delay units which generate the functions of base lines, bats, bat positions, ball and ball positions. Notice, immediately, that the left and right bat vertical positions are set by voltages from potentiometers feeding voltage controlled delay units. Similarly the ball's horizontal and vertical positions are set by the Ball Horizontal and Vertical Control units—each of which is triggered by a Horizontal and Vertical Change signal. All the other delay parameters are preset.

The AND gates just to the right of the delay units provide horizontal and vertical coordination for the left and right bats and ball. The seven waveforms emanating from the delay units are: TOP BASE, BOTTOM BASE, LEFT BAT, RIGHT BAT, LEFT BASE, RIGHT BASE and BALL.

Ball control

Generating these waveforms utilises most of the systems circuitry; the remainder performs fairly simple logic operations on these signals. Although the ball is only seen on the screen during a game it is there all the time, bouncing around between top and bottom or left and right base lines or the bats! Between games it is blanked by the logic circuitry.

Now to deal with that circuitry. First of all the Vertical Change unit which detects when the ball "hits" the top or bottom base lines. A "hit", in reality, is coincidence of signal between the BALL and one of the base line waveforms. If we get BALL. TOP BASE (coincidence between the ball AND top base) the vertical change system detects this with an AND gate. This sets a flip flop, the output signal of which causes a ramp generator to start a voltage sweep that increases the delay in the Ball Vertical Position unit. Eventually, of course, there will be coincidence provided by BALL. BOTTOM BASE; this is detected by Vertical Change and the direction of the control ramp is reversed by the Vertical Change flip flop changing state.

To control the ball horizontally we need it to "bounce off" either the left or right base lines or the bats. Because the bats are inside the court, when they are in the correct vertical position we shall get coincidence with their signals before the respective base lines. Nevertheless it is necessary to get Horizontal Change signals from either BALL. (LEFT BAT + LEFT BASE) or BALL. (RIGHT BAT + RIGHT BASE). These signals are detected and processed by the Horizontal Change unit in exactly the same way as for the vertical operation. Provided both these systems work the ball will stay within the court, bouncing about as already stated. There is only one problem—the ball must be inside the court to start with, otherwise it can never get in. This is a switch-on ambiguity and is overcome by means of a push button on the front panel which, for want of a better name, we call the Ball Boy. This centralises the output voltages of the two ramp generators. It is not shown on this simple diagram.

Service

To complete the system all we need is a method of brightening up the ball at the start of a service and ensuring that it stays bright until one of the players misses it. A miss is detected by coincidence between the ball and either the right or left base lines. In ideal play the ball never hits these because it would have hit a bat first. BALL is ANDED with RIGHT BASE + LEFT BASE and the LOSE signal is then fed via the push button contacts S2b and S3b to the Ball Blanking circuit. If either of these coincidences occurs, the flip flop in Ball Blanking prevents the ball waveform passing through the following AND gate. The ball will then stay blanked until the next service.

Each player has a push button which generates either a RIGHT SERVE or a LEFT SERVE signal. We arrange that if the LEFT SERVE signal is present and the BALL is coincident with either LEFT BASE or LEFT BAT it will bright-up. This logic is effected by the AND gate shown immediately below the representation of the Left Service button. A similar signal is produced if the RIGHT SERVE signal is present when the ball hits the right hand base line or the right bat. Both right and left serve control signals are fed via an OR gate into the other side of the Ball Blanking flip flop. The switches on the input to the LOSE side of this flip flop prevent coincident signals on both inputs. This could have been done by logic but it was felt more economic to use the spare contacts of the service push buttons. We have now modified our original BALL waveform to BLANKED BALL.

Video mixer

All the waveforms are now combined in the Video Mixer which is a simple diode OR gate. They are then blanked to prevent their occurence during field and line sync pulses and fed to the Sync-Video Mixer. This circuit algebraically adds the correct proportions of video and sync to produce the composite video output signal. The source impedance is a few hundred ohms as opposed to the normal 75Ω, but the signal level is greater than the standard 1V peak to peak so when loaded with 75Ω this drops to a normal amplitude. It is assumed that not many people will want to use a video monitor and so this signal is used to modulate a uhf carrier for injection into the aerial socket of a conventional television set. The modulator used was designed by the British Amateur Television Club and is offered in kit form by Crofton Electronics.

This design will only operate satisfactorily on UK 625-line standard. The same principles can be adopted for other TV systems but some of the timing components will need different values, and radio frequences and modulation polarities will be at variance.

Next month in Part 2 we shall deal with the Power Supply, the Modulator and the Video Mixer.

GOING BACK...

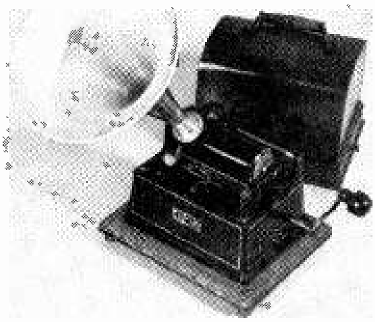
1970 60 50 40 30 20

COLIN RICHES

The Edison "Gem"

IN 1892 the British rights of the Bell-Tainter and Edison phonograph were sold to the Edison Bell Phonograph Corporation Limited.

1898 saw the re-organisation of the company as the Edison Bell Consolidated Phonograph Company. It was amalgamated with Edisona Limited, a company which had been importing machines from America.



Our Edison 'Gem".

One of the most popular cylinder playing machines manufactured by Edison was the "Gem" like that shown in the accompanying pictures. It is described as the "baby" of the Edison phonograph range and first appeared in 1899 when it was introduced to compete with other small models then on the market.

Collectors of cylinder machines will find that the "Gem" is still the smallest practical machine for regular use although most have a motor mechanism which tends to be somewhat noisy. Five models were manufactured.

The "Model A" had a simple spring motor which played one 2-minute cylinder per wind. In the very early models, the motor was fitted in the left-hand end of the casing as viewed from the front of the machine but was, in later models, turned 180° and mounted at the other end.

It is thought that this change in positioning of the motor took place around 1901 when the "Gem" was fitted into a cabinet. All "Model A Gems" were fitted with a black-japanned horn.

From 1899 to 1901, the "Gem" was supplied minus a cabinet though a "drip pan" to catch the excess oil was screwed to the base. In 1901 it was equipped with the round-topped cover and wooden base and looked rather like a mini sewing machine.

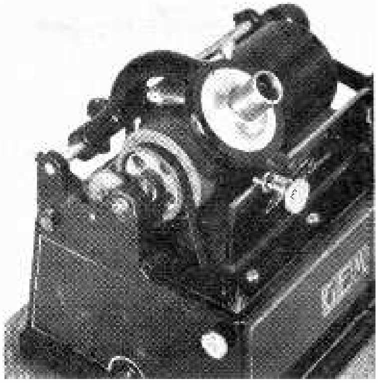
The body was cast iron finished in black enamel with gilt embellishments. The mandrel, over which the cylinder fitted was of polished nickel. Early cabinets had "Edison Gem Phonograph" branded on the lid but this soon gave way to the more familiar "banner" transfer like that on our machine.

The speed adjustment screw and starting knob were combined on the right-hand front corner of the body but in 1901 this was moved to the left-hand side. It was a knurled button which operated a cam movement.

"Model B" was basically the same as its predecessor but the winding key gave way to a crank which was wound clockwise through the inclusion of an extra gear. An aluminium horn was supplied with the "Model B" and this is thought to have been a step introduced to tide the machine over until a larger and more effective horn came into production.

The "Model C" was very similar to "Model B" but had a socket fitted on the body to enable a crane rod to be slotted. This supported a rather large horn.

The "Gem Model D" was introduced into this country in 1909 and was the only "Gem" designed to play both 2- and 4-minute cylinders. The cabinet was oak and the metal body of the machine was finished in maroon with gilt and black lining.

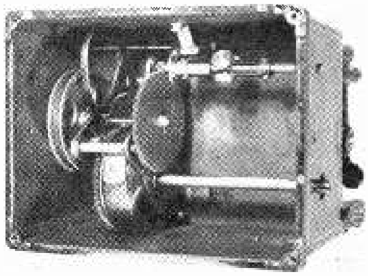


Drive belt and speed adjuster.

1912 saw the introduction of the "Model E". It had 4-minute gearing only but in all other respects was similar to "Model D".

The "Gem" range was discontinued in 1913 with the price of the "Model E" being £3 3s.

An excellent book, if you are interested in learning more about Edison Cylinder Phonographs, is entitled, "A Guide to The Edison Cylinder Phonograph". It contains details of the spring-driven models produced from 1859-1929 and has been compiled by George L. Frow to whom I am indebted for supplying some of the information on the "Gem" machines.



Speed governor mechanism.

Mr. Frow is always on the look-out for new information on Edison machines, so if anyone would like to write to him, he can be contacted at "Salterns", Seal Hollow Road, Sevenoaks, Kent. Another useful reference for vintage "gramophone" enthusiasts is the Talking Machine Review. It is edited by Mr. Ernie Bayly and appears at regular intervals throughout the year. Further information may be obtained by sending a s.a.e. to Mr. Bayly, 19 Glendale Road, Bournemouth, BH6 4JA.

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Unmarked Untested Paks

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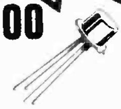

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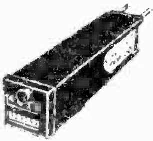

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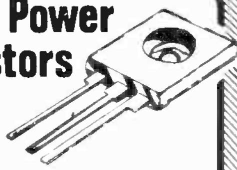

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HOTLINES ON RECENT DEVELOPMENTS

BR-BR, BR-BR

Have you ever wondered what is going on behind the scenes as you stand and wait for your train as accident, industrial dispute or weather strike at services. The worst part often seems to be that no-one knows what is happening. When will a train materialise and, when it does, what platform will it be on? The fact that the only visible means of communication for some station staff is one of those mahogany-cased telephones of yesteryear hardly inspires confidence.

The problem is, of course, that any industry where safety is so vital has to be very sure indeed of the reliability of equipment and systems before adopting them for general use. There have been changes — recently the more observant will have spotted the UHF pocket radiotelephones in use by senior platform staff of some regions of British Rail.

Those of you who brave the melée of London Bridge each day may well have wondered what the future holds, with all the new signalling arrangements now being installed.

In a paper presented recently to the Institution of Railway Engineers, it was revealed that a mini-computer installation with disc storage at London Bridge will form the heart of the new system. The track diagram in the signal box is divided into eighteen sections and includes CRT displays of train running and signal aspect information.

At the associated London termini, station supervisory staff will have visual display units (VDU's) which can be switched to show the situation on any of the eighteen sections. Information displayed will include the position of trains, whether moving or at platforms, identified by their alphanumeric reporting numbers. "Train ready to start" signals will appear as a flashing symbol. The station platform "Next train" indicators will also be controlled by the computer.

Trials already carried out by B.R. have proved the feasibility of operating a computer continuously all the year round in the environment of a railway signal box equipment room. An MTBF of about 8000 hours has been achieved in these trials. Additional reliability in the London Bridge installation is provided by a standby mini-computer, whilst VDU's are available in the signal box for use in the event of failure of one of the main CRT displays.

Facilities are included for timetable changes to be fed into the system and activated automatically on the due date. A future addition may be for the computer to control routing at junctions. If that comes about, it sounds as if the system will almost run itself !

COWSHED COMPUTERS

Latest application of data processing is in the running of dairy herds. Using a micro-computer to maintain records of feed, health and milk yield of each cow is claimed to double the number of cows which can be handled efficiently by a herdsman. The farmer will also be provided with data on operating costs and income.

STRIKE A LIGHT

Talked about for quite a while, the light-sensitive thyristor is here at last. Announced by Motorola at the Paris Components Show are two ranges of device handling 250 and 400mA with PIV ratings from 15 to 200V.

Also new from Motorola are three Darlington power transistors with 15A current capability and large-signal current gains of up to 5000. Base to emitter shunt resistors and a shunt diode between collector and emitter of the output transistor are incorporated —all this in a standard TO3 package!

ON THE BEAM

We hear that scientists at the RCA Laboratories are working on a modulator which could put 25,000 telephone calls or 20 TV channels on a single laser beam.

The device requires very much lower modulating powers than previously necessary and is compatible with ICs. Modulating voltages are applied to metal fingers which influence the passage of light through a thin-film optical waveguide.

OPEN SESAME!

Hitherto more or less confined to the realms of science fiction or detective novels, the voice-operated lock could become a practical proposition in a couple of years if research now under way at the Westinghouse Laboratories in New York is successful.

When we speak, air is expelled from the lungs past the vocal chords, causing them to vibrate. These vibrations chop the air stream up into a string of pulses which travel up the vocal tract to the lips, giving the basic pitch to the voice. On their way, the frequency spectrum of the pulses is modified by resonances of the tract, chiefly in the throat, mouth and nose, to produce the final sound.

These resonances, which are known as formants, are different for each person and produce "voice-print" patterns as distinctive as fingerprints.

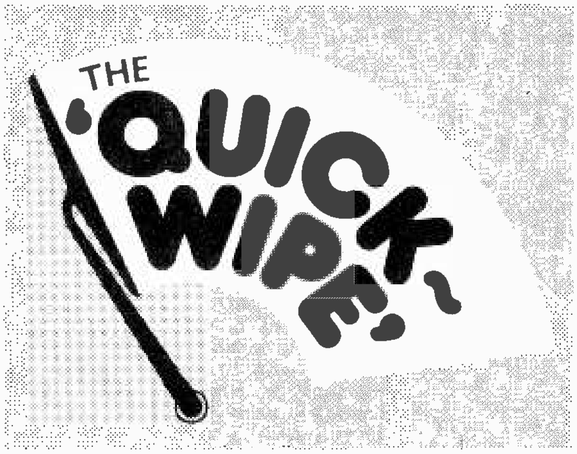
Voice-identifying locks have been produced before, but needed complex filters and large computers and cost up to $100 000. By using a different filter system and a smaller computer, Westinghouse hope to produce their lock for under $100.

The lock could be set to respond to several voices and the password changed as often as necessary. Besides security applications, the system could be used for " no-hands " operation of machinery.

One point worries me. What happens when you have a cold or a sore throat, or even on the morning after the night before?

Novus

MODIFYING



P. S. COLLINS

DUE to the series arrangement of the 'start' and 'park' switches of the wiper motor on some cars, Fig. 1, the original circuit and wiring must be modified. Figure 2 shows the modified circuit. The basic circuit remains the same, but Tr5 drives a relay instead of the motor directly. The relay contacts effectively replace the car's wiper switch. S1 is thus rewired to provide the choice of variable delay or continuous operation, with centre 'off'.

It will be noted that in the continuous position RL1 is driven by a direct earth through S1b and S1a provides the 12V. 12V is also present on the rest of the delay circuit but its effect is nil as Tr5 is short circuited.

Figure 3 shows the modified wiring arrangement. RL1 may be glued to the box lid or a larger box (RS Comps. type 993) could be used to house all the components including the relay.

The circuit shown is for negative earth systems. For positive earth, D3 must be reversed. ■

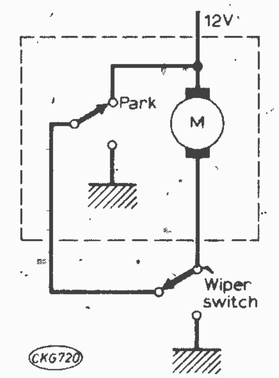
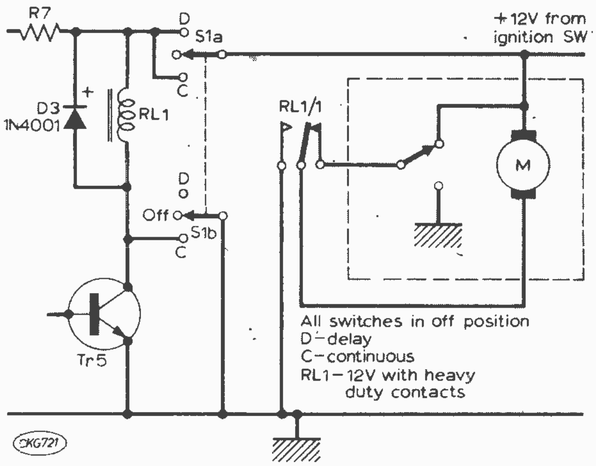
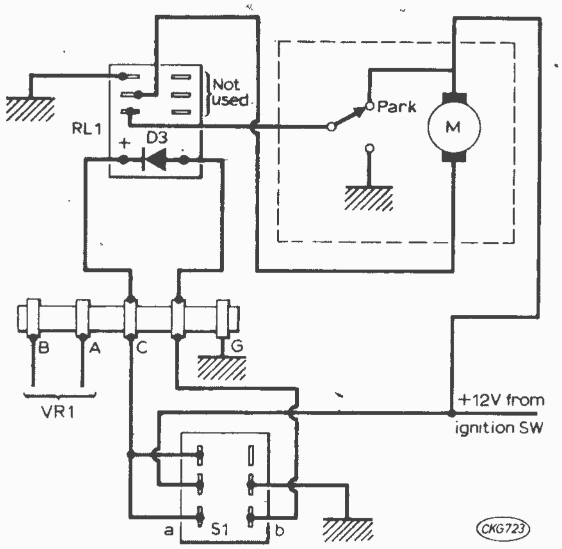


Fig. 1: This switching arrangement of windscreen wipers found on some vehicles will prevent the proper operation of the Quickwipe circuit described in the April issue.

Fig. 2: bottom left, is the modified circuit using a relay to drive the wipers.

Fig. 3: Rearrangement of the wiring to incorporate the new relay circuit. Unless a sealed relay is used the relay should be enclosed in a box with the rest of the components. The connections from the PCB to the terminal strip remain as in the original article.





GENERAL PURPOSE PREAMPLIFIER

A. FOORD

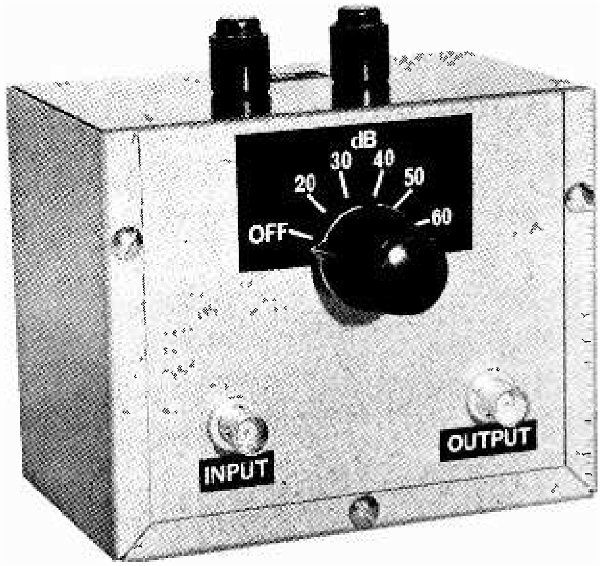
THIS amplifier is designed for audio or measurement applications where an AC coupled amplifier of well defined gain and low noise characteristics is required. Fixed gains of 20, 30, 40, 50 and 60dB are provided. The noise referred to the input is 0·5μV, which is low enough for most audio requirements.

General purpose amplifiers such as the 741 types are limited in frequency response and have a relatively high input noise. For example, the 741 circuit shown in Fig. 1 will have a bandwidth of about 1kHz when the overall gain is 60dB. With the 741 the open loop frequency response is shaped so that the closed loop is stable under all conditions, including unity gain applications. Some amplifiers such as the 748 and 301 have external frequency compensation which can be tailored to suit the application. However the improvement is only a factor of ten, giving a bandwidth of 10kHz when the overall gain is 60dB. Even the less readily available amplifiers, such as the LM318, which are designed for wide bandwidths can only give a 30kHz bandwidth when the gain is 60dB.

CAUSE OF LIMITED BANDWIDTH

The frequency is normally limited by the bandwidth of the lateral PNP transistors used for level shifting in the input stages and by the low collector currents which are used so that the input bias currents may be reduced and an excellent DC performance obtained. For many AC applications the DC characteristics are of secondary interest.

While special low noise integrated circuits are available the approach indicated here gives an improved performance with little added complexity and cost. In Table 1 this technique is compared with the readily available standard integrated circuits.



Maximum Output	4V RMS
Output Resistance	50Ω
Input Resistance	47kΩ

Gain (dB)	Bandwidth
20	10 Hz to 700kHz
30	10 Hz to 700kHz
40	15 Hz to 700kHz
50	10 Hz to 700kHz
60	20 Hz to 400kHz

Bandwidth	Noise referred to input (50Ω source)
100Hz to 10kHz	0·31μV
100Hz to 30kHz	0·48μV

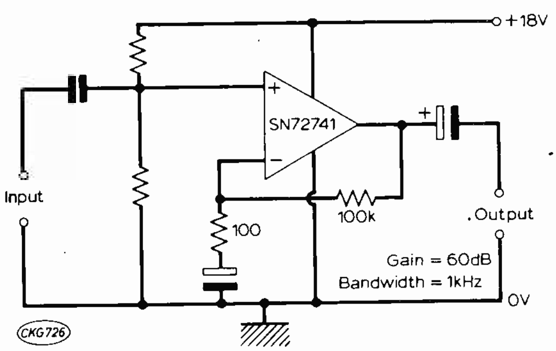


Fig. 1: Simple amplifier using the standard 741 integrated circuit.

TABLE 1

AMPLIFIER	GAIN (dB)	BANDWIDTH (kHz)	RELATIVE NOISE
741 series (internal compensation)	60	1	20
LM318 wideband amplifer	60	30	15
LM381 low noise amplifier	60	20	5·5
301 series (external compensation)	60	10	16
748 series (external compensation)	60	10	20
Suggested Circuit	60	400	2·1

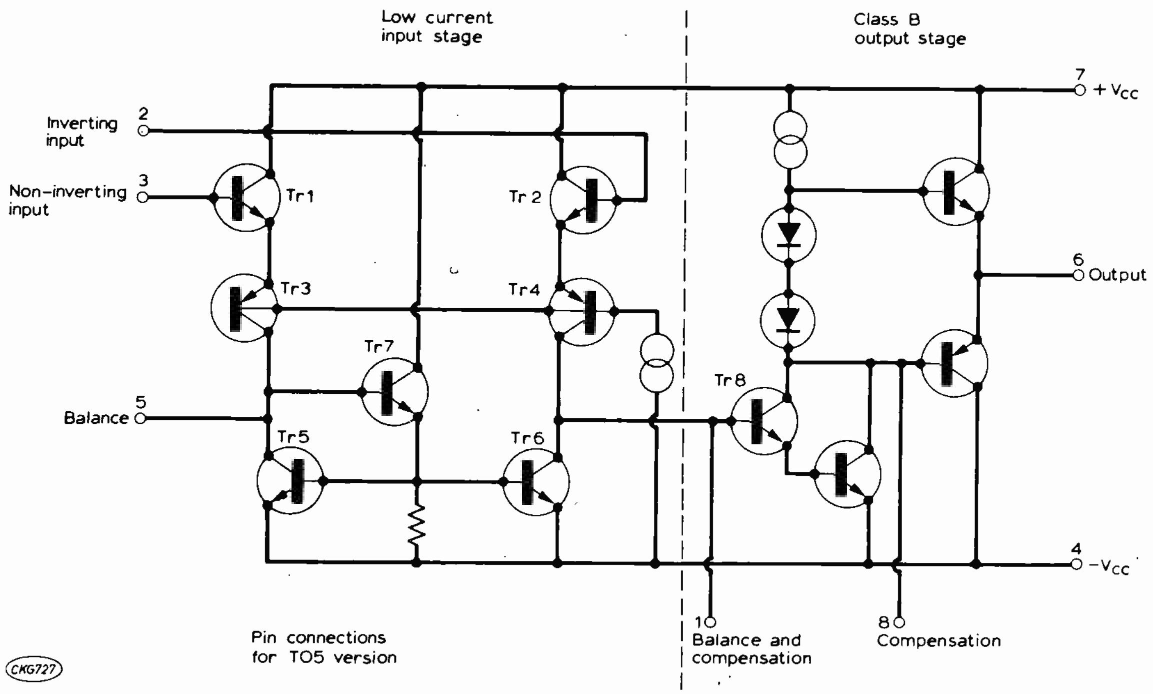


Fig. 2: Simplified diagram for the 301 integrated circuit.

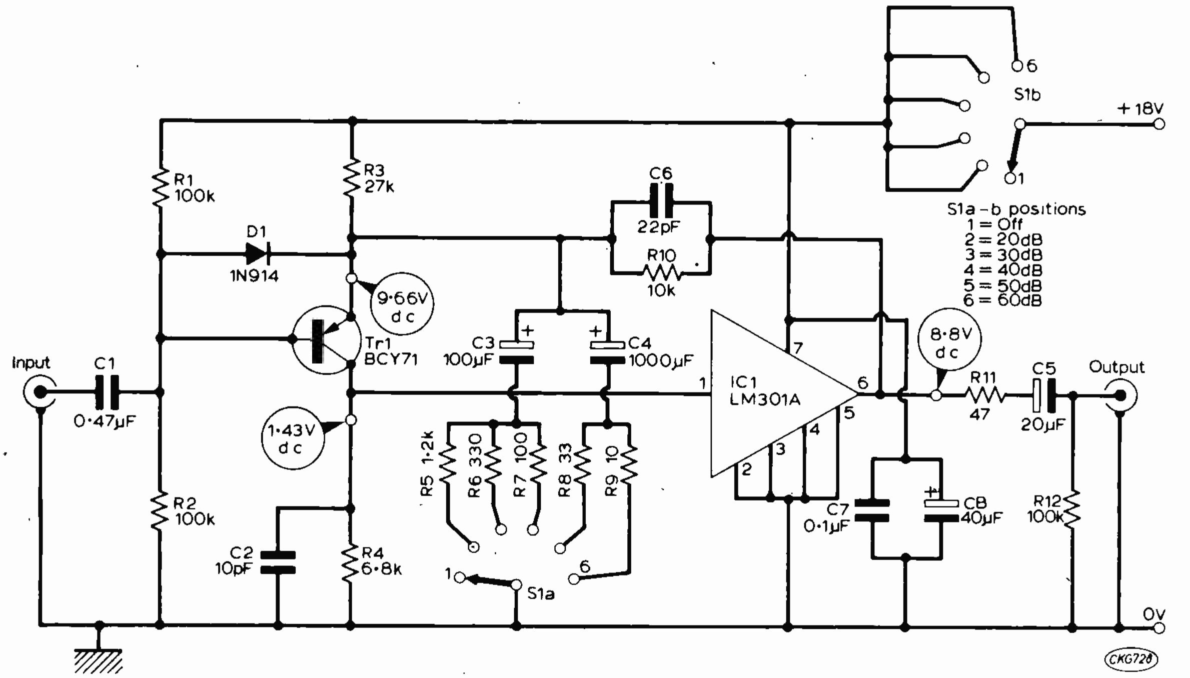
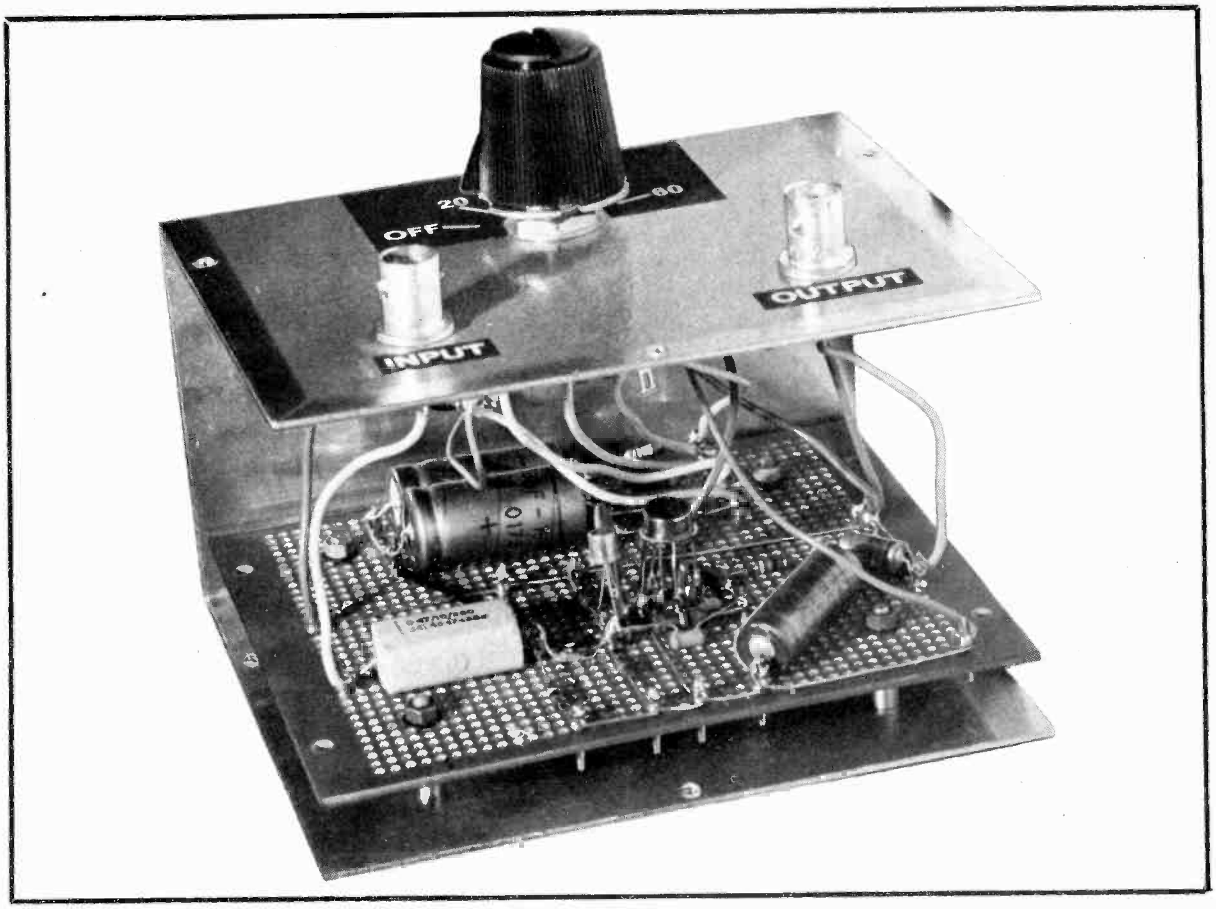


Fig. 3: Complete circuit of the final arrangement of the wideband pre-amplifier.

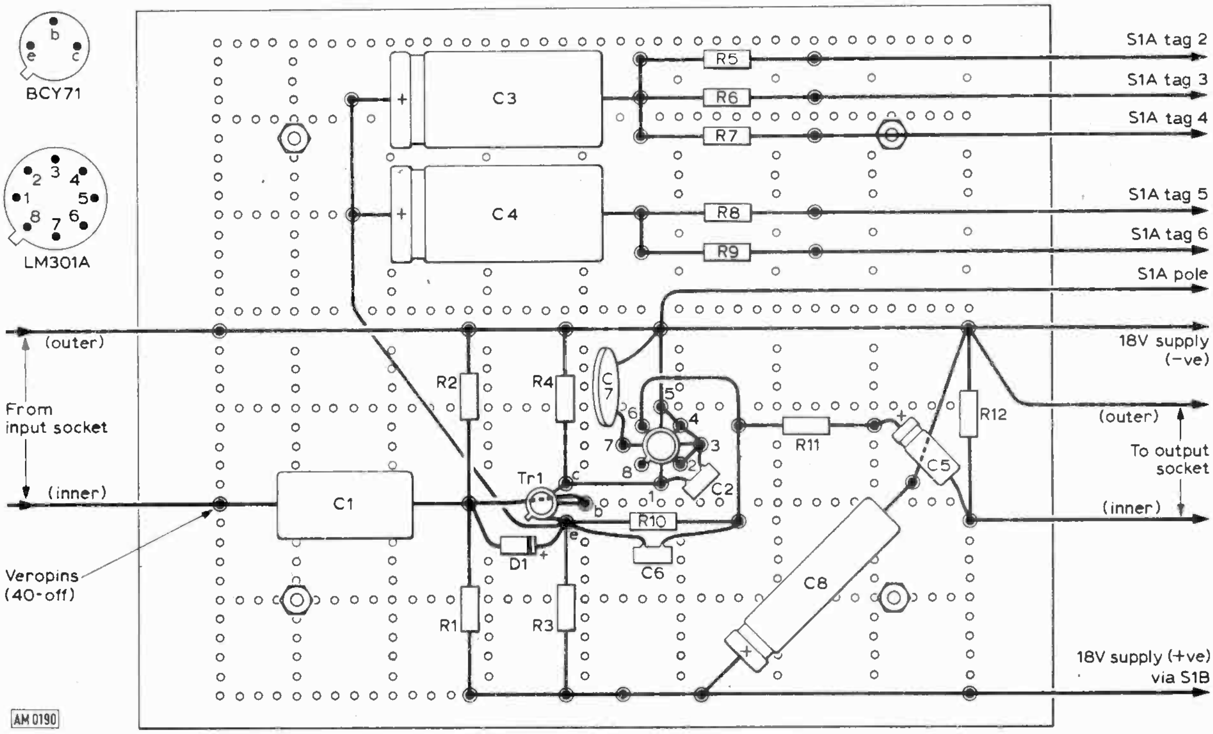
A simplified diagram of the 101, 201 and 301 family is shown in Fig. 2. The main limiting components occur in the input stages, before Tr8. The second stage, from the base of Tr8 onwards, has a high gain with good bandwidth, good current capability and short circuit protection. This section of the integrated circuit should be retained, but the input stage should be replaced. Fortunately the base of Tr8 is accessible because this point was used for offset voltage balancing purposes. If pins 2, 3 and 5 are connected to the most negative supply point (pin 4) then the complete input stage is effectively disconnected.

COMPLETE CIRCUIT

The construction is straightforward, Fig. 4, but the input stage is replaced by a single PNP transistor Tr1 in a common emitter configuration which drives the output stage via pin 1. The gain without negative



In the finished pre-amplifier, above, the circuit board is mounted about ¼in. off the case to clear the veropins. Fig. 4: (below) gives the board layout and wiring.

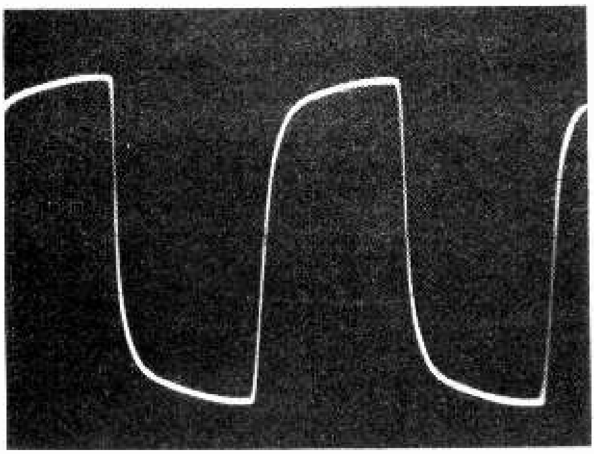


feedback is about 80dB which allows the gain with feedback to be well defined. This is achieved by R10 and R5 to R9, to give the switched gains shown. Capacitors C2 and C6 shape the frequency response and ensure stability for the closed loop gains allowed by S1.

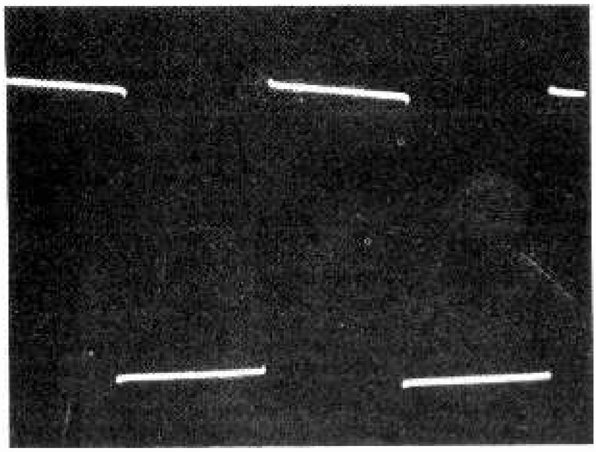
When the unit is switched on C3 or C4 will take a little while to charge up to the operating voltage and the base-emitter junction of Tr1 will be reverse biased for this time. Although the breakdown current would be limited to a 'safe' value this action can increase a transistor's noise level. Any reverse base-emitter voltage is therefore limited to a safe value by the conduction of D1. Under normal operating conditions D1 is reverse biased and cannot affect the circuit's operation.

CONSTRUCTION

The construction is straightforward, Fig. 4, but the unit must be placed in a metal box if hum pickup is to be avoided at high gain levels. Due to the bandwidth of this circuit all wiring should be keep short and the decoupling capacitor C7 placed directly across the pins of IC1. In critical applications the unit should be run from batteries (inside or outside the box) to reduce hum and earth loop difficulties.



The output of the amplifier with the gain at 60dB and a 100kHz squarewave input.



Here the gain is still 60dB but the input is 1kHz squarewave.

★ components list

Resistors

R1	100kΩ 5%	R7	100Ω 2%
R2	100kΩ 5%	R8	33Ω 2%
R3	27kΩ 2%	R9	10Ω 2%
R4	6·8kΩ 5%	R10	10kΩ 2%
R5	1·2kΩ 2%	R11	47Ω 5%
R6	330Ω 2%	R12	100kΩ 5%

All resistors are ¼ watt

Capacitors

C1	0·47μF polyester	C5	20μF 16V
C2	10pF ceramic	C6	22pF ceramic
C3	100μF 16V	C7	0·1μF „ disc
C4	1000μF 16V	C8	40μF 25V

Semiconductors

D1 1N914 Tr1 BCY71
IC1 LM301A, SN72301A or similar TO5 version

Miscellaneous

S1, 2 pole 6 way wafer switch. Terminals (2). Sockets (2). Veroboard and pins. Knob. Case approx 5 x 4 x 3in.

When the unit is tested a single DC measurement at the output of IC1 (pin 6) will confirm that the circuit conditions are correct. This is a low impedance point and it does not matter if the multimeter requires a few milliamps to operate it. Although a nominal 8·8V was measured on the prototype, variations of perhaps ±1 volt would be normal. If an oscilloscope is available R3 may be changed, by one preferred value up or down, until the output limits symmetrically.

NOISE LEVELS

The design of a low noise amplifier is complex, depending on the source impedance, the gain and bandwidth required and the transistor parameters. For this application a collector current of 220μA has been chosen for Tr1; which is a good compromise for general wideband applications. For all transistors the noise increases at low frequencies.

If the circuit is specifically required for audio applications, where the 400kHz bandwidth is not necessary, the performance may be improved by reducing Tr1's collector current. Experienced constructors with the necessary test equipment could redesign the circuit for a collector current of between 50 and 100μA. ■

P.W. ELECTRONIC COMPONENTS BUYERS' GUIDE

Special supplement in the October issue giving details of components commonly available, followed by additional sections in succeeding issues. More details on page 116 of the June issue.

COMPONENT SUPPLIERS

Have you sent us your catalogues or lists for use in compiling the P.W. Buyers' Guide? Closing dates: 17th June for information; 1st July for advertisers in the October supplement only.

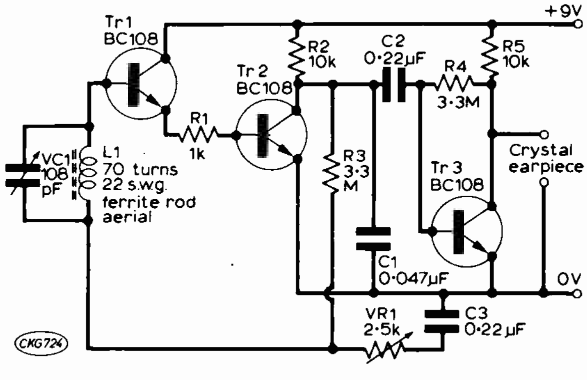
TAKE 20

DAVID ANDREWS

No. 61
PERSONAL TRF RECEIVER

A series of simple transistor projects, using not more than twenty components.

UNLIKE many simple radio receivers this one will operate first time without any messing about with regeneration. It uses a straightforward parallel tuned circuit with the coil wound on a ferrite aerial rod. This is directly coupled to the RF amplifier/detector formed by Tr1 and Tr2; the rectified carrier is suppressed by C1 and the detected audio fed to one stage of AF amplification Tr3. The output goes to a crystal earpiece and when the set was operated in a notoriously bad reception area in a valley in the South East it pulled in ALL the major broadcasting stations, including London Broadcasting and Capital Radio. The output level was almost comparable with a similar circuit using a ZN414 followed by an identical amplifier!



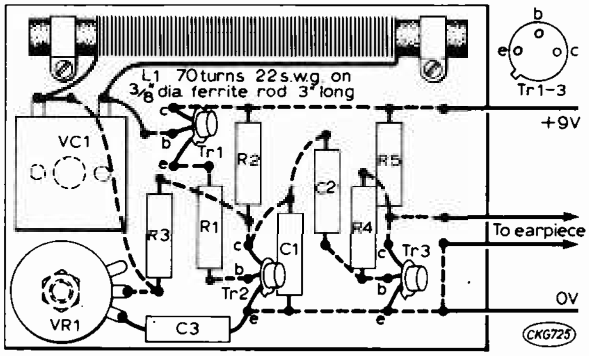
Circuit of the TRF receiver. No external aerial is required with this set.

The secret of its excellent selectivity is the very high input impedance provided by the emitter follower action of Tr1; the loading on the tuned circuit is minimal and maximum Q can thus be obtained. A warning to some constructors—the tuning is so sharp that you have to tune slowly to prevent overshooting the station. There is a high degree of RF amplification which obviates the need for regeneration. The quality is thus excellent and there are no setting up problems.

★ components list

R1	1kΩ	VR1	2·5kΩ linear
R2	10kΩ	VC1	108 or 150pF
R3	3·3MΩ	L1	See Fig. 2
R4	3·3MΩ	Tr1	BC108
R5	10kΩ	Tr2	BC108
C1	0·047µF	Tr3	BC108
C2	0·22µF	Crystal earpiece	
C3	0·22µF	Ferrite Rod 3" × ⅜" dia.	

There are only two snags. The circuit is rather sensitive to fluorescent light interference and if operated too close to mains cables a certain amount of hum is induced. As a pocket portable neither of these points should present practical problems.



The set may be built on a piece of Veroboard, with pins, as shown here

Sensitivity is so high that it is necessary to include a volume control (we really do mean this, if you have any local stations!). To achieve this we introduce a controllable amount of negative feedback by adjusting the effect of decoupling capacitor C3 with VR1. Several test models have been built and with some high gain transistors there is a tendency for the circuit to oscillate which is easily prevented simply by reducing the gain by turning down VR1. For those who can't afford a ZN414 we assure you that this circuit gives very comparable results.

SPARE A THOUGHT...

TO what extent do you maintain your fullest interest in radio, electronics and allied practical activities? Maybe you consider it to be a winter pastime, but from evidence that we have, summer issues of P.W. are still gobbled up from the bookstalls at an incredible rate. What does seem to be the case is that often you may decide to get your copy from a different source, for example in holiday resorts or nearer your home, whereas previously you might have purchased from the station bookstall on the way to your place of work.

Regular orders through newsagents can be delivered to your door, but if it does not arrive when expected, the newsagent is the first in the firing line for questions. Occasionally, factors outside his immediate control intervene and delay publication. We cannot, unfortunately, inform all newsagents and readers quickly enough when this happens and it is regretted that these occasions ever have to occur. So please have some patience with the newsagent. It may not always be his fault!

Oscilloscope techniques

PART 5

ALAN AINSLIE

X DEFLECTION AND TIMEBASE

In the first part of this series we considered the requirements for a timebase system, namely the generation of a linear sawtooth coincident with the recurrence of the signal under observation. There are two basic modes of timebase operation, sync or trigger. We shall consider sync timebases first.

The synchronised timebase is a free-running generator of sawtooths; when one cycle is complete the next one starts with no time gap. A portion of the Y signal, derived from the Y amplifier by a cathode follower, is fed to a "sensitive" part of the circuit and this keeps the timebase in step with the Y signal. Fig. 1 shows how a sine wave is traced on the screen in this manner. However, the timebase is unable to cope with the requirement of a scan of duration less than one period of the waveform being examined.

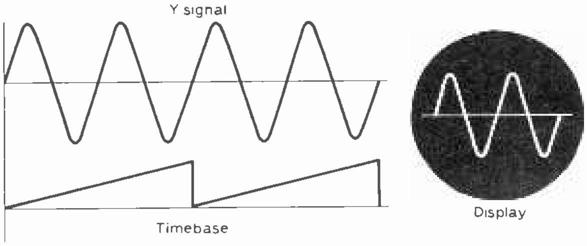
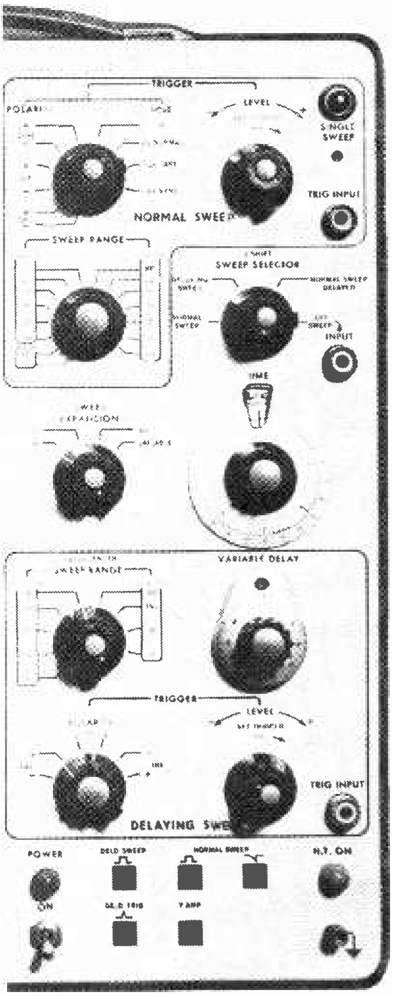


Fig. 1 : Generation of a sine wave on a CRT screen

The sawtooth can be generated in a number of ways, all involving charging a capacitor linearly and producing the scan, then discharging it, producing the flyback. The flyback trace interferes with the main trace and so a means of cutting off the trace during flyback has to be found. If the capacitor charges up in a positive manner and is then discharged through a resistor, this resistor will have a positive pulse across it during flyback. If this pulse is capacitively fed to the CRT cathode the trace will blank out during retrace, as required.

CONTROLS

The controls on a sync timebase are frequency, sync and, sometimes, width. The sync control selects the amount of Y signal used to sync the timebase. If too little is applied the trace will not lock and if too much is applied the trace will "fold up". The width control is adjusted for a satisfactory image width on the screen.



The timebase facilities on a dual timebase oscilloscope

The output from the timebase is applied to an X amplifier which may have to produce 100 or 200V deflection. The bandwidth required is only a couple of MHz and small scopes may use a simple single valve output. Usually push-pull or balanced output is used and the sawtooth can be applied to one valve and again (as in the Y system) a calibrated shift control can be used to drive the other grid. Fig. 2 shows the X amplifier used in the EMI WM16 scope.

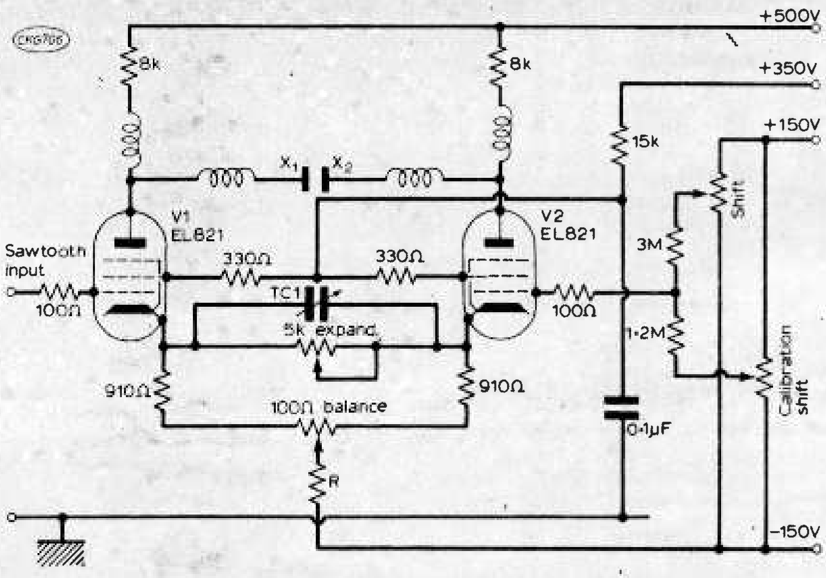


Fig. 2: Circuit of the X amplifier in the EMI WM16 oscilloscope

TYPICAL X AMPLIFIER

The two valves can be seen to form a simple phase splitter. The coils and TC1 peak the HF response. The 5kΩ variable pot between the cathodes is in fact a switched series of preset resistors giving calibrated X expansion. Resistor R in the cathode is in fact a constant-current valve. The operating point of the valve can be adjusted to vary the X plate potentials and these are adjusted to be equal to the potential of the Y plates with the spot central, to minimise spot distortion. The balance control is set so that the cathodes of the two valves are at the same potential when the spot is central (i.e. varying the 5kΩ between cathodes has no effect on the spot when central).

TRIGGERED TIMEBASES

Most timebases in use are of the triggered variety permitting much greater flexibility than the sync timebase. In this mode of operation a sweep length control selects the duration of the sweep, the sweep beginning when the timebase generator receives a pulse from the trigger amplifier.

Fig. 3 shows the general requirement for a trigger amplifier. The Y signal is sampled from the Y amplifier by a cathode follower. The signal is amplified and "phase split". A "trig polarity" switch selects one or the other of the phase splitter outputs which is applied to a comparator and compared with a DC level set by the "set trig level" control. The comparator produces a pulse when the comparator input bears a certain relation to this DC voltage selected on the "set trig level" control. This pulse is taken to the timebase to initiate the scan process. The pulse will occur once per input cycle at the same level as shown in Fig. 4.

The trigger pulse "flips" a bistable which starts the capacitor charging process. The multivibrator will now accept no further trig pulses until it returns to its former state. The capacitor selected by the range switch is charged by a constant-current valve, the value of the current being set by variable resistors also selected by the range switch, these being the sweep calibration presets. The ramp produced by the charging of the capacitor is amplified by a cathode follower and fed to the X amplifier and also to a comparator. When the level of the ramp passes a certain level the comparator produces a pulse which initiates the discharge of the capacitor. The bistable is also triggered into its original state, but is only allowed to return at a rate comparable with 2% of the sweep length, allowing complete recovery of the circuits before trigger pulses are again accepted.

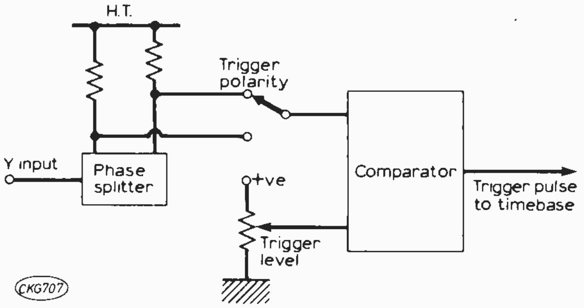


Fig. 3: Basic arrangements for a trigger amplifier

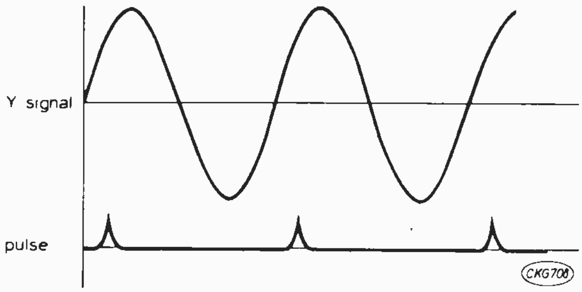


Fig. 4: Relationship between Y signal and trigger pulse

A trigger sensitivity control, "set trigger" or "stab" allows for variation of sensitivity of the bistable and when the control is fully clockwise it is usual for the bistable to "free run" with the sawtooth giving a continuous output. Any signal applied to the grid of the bistable will synchronise the timebase, rather than trigger it, and a position of the trig polarity switch usually allows for the Y signal to be fed to the grid of the bistable, rather than the normal pulse.

The bistable is also used to provide bright-up for the tube. Sync timebases require only flyback blanking but as a triggered timebase may be "waiting" for a trigger pulse the tube is normally cut off and is brightened up by a bright-up pulse occurring during the scan. Fig. 5 shows the sequence of events as a time graph. Note that the bistable takes slightly longer than does the ramp to revert to its initial state. The waiting time is also clearly seen.

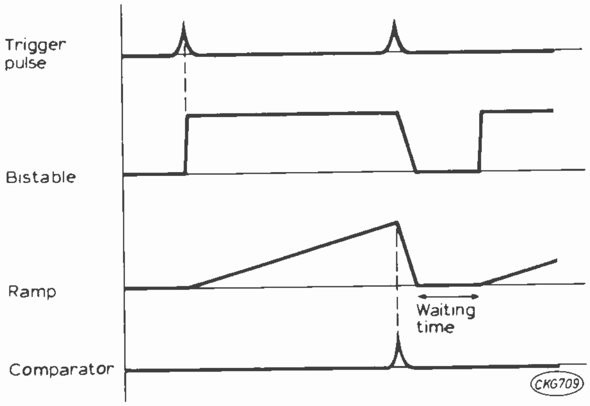


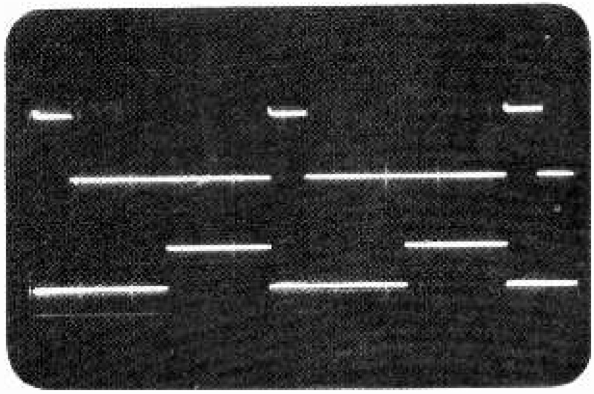
Fig. 5: Waveforms at different points in the triggered timebase

In use there are only about five controls. The sweep length control is set to the required sweep period (it can of course be much shorter than the period of the signal being viewed). There is usually a trigger polarity switch and a mode switch. This allows for triggering from very low frequencies, or very high frequencies or automatically. Oscilloscopes for TV use also have TV frame and line positions in which a sync separator is switched into the circuit. The trig level and stability controls have already been mentioned and operation of the timebase is very straightforward. Automatic triggering is used on simple waveforms as there is no need to set the trig level control. Operation is thus simplified.

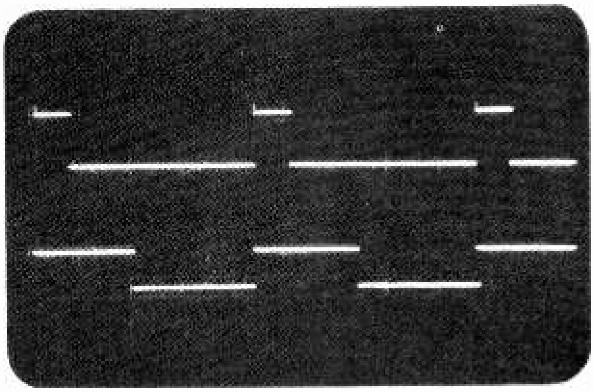
The mode switch is set to that which seems most suitable and the "stab" or "sensitivity" or "set trigger" control is set fully clockwise and the timebase should then free run. Backing off the "stab" control and rotating the "trig level" control should give a point at which a rock steady image is obtained. The sweep length control can then be switched to any range without any other adjustments being necessary.

DUAL TRACE PROBLEMS

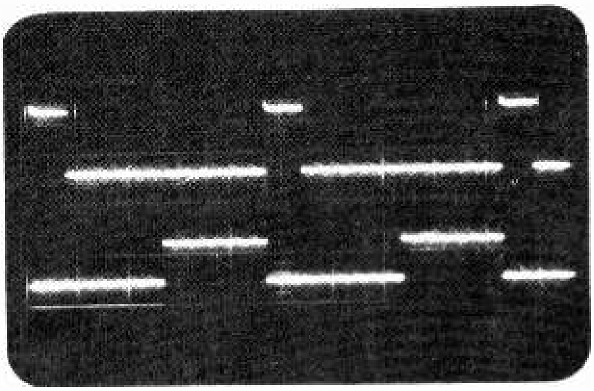
When triggering from a dual trace display (produced electronically) in the "ALT" mode it is possible to lock to one trace or the other, but not both unless they are overlapping. This can be overcome by very careful adjustment but the best way is to apply external trigger pulses from one of the signals if the loading of the trig input is not too great. Otherwise it will be necessary to allow some overlap and adjust the trig level control to trigger off the overlapping portion. Similar difficulties arise in the "chop" mode because the scope tends to lock to the beam switching waveform. Once again external triggering may be needed.



The two outputs of a double pulse generator shown correctly on "ALT" with external trigger. It can be seen that the lower trace dropping to logic '0' triggers the upper trace to logic '1' . . .



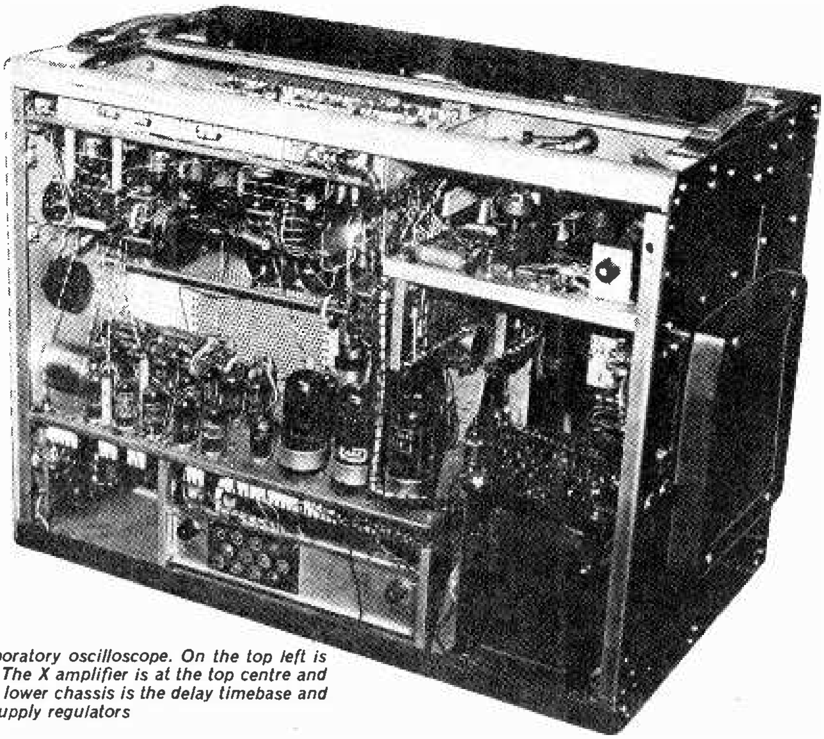
The same pulse generator output on 'ALT' but with internal trigger. The two traces both lock on the positive going edge and the time relationship is meaningless



The same pulse generator displayed on 'CHOP' with internal trigger. The 'trig level' control is set so that the timebase triggers from one signal only. The timing relationship is correctly displayed. Unfortunately the sweep speed is such that switching transients upset the trace considerably

TIMEBASE OPERATION

Most oscilloscopes provide an external X input but it must be remembered that the bandwidth is only a few MHz except in XY oscilloscopes where the X



The timebase section of a laboratory oscilloscope. On the top left is the main timebase generator. The X amplifier is at the top centre and the EHT unit at top right. The lower chassis is the delay timebase and power supply regulators

and Y amplifiers are identical. Several oscilloscopes are provided with two timebases, one being the normal one, the second being a delay timebase. The second timebase can be identical with the main timebase or very much simpler, as in the Cossor 2000. The purpose of the delay timebase is, as its name implies, to delay the main timebase. It is triggered from the signal and starts its sweep. At a certain point the main timebase triggers from the sweep and scans the CRT. The operation of the delay timebase is shown in Fig. 6. The time of the delay is adjusted by selecting the point at which the delay trig pick-off produces a pulse.

In order to gain some idea as to the operating point of the main sweep most scopes arrange for the delay timebase to scan the tube. Thus the triggering can be seen to be correct. No bright-up pulse (or only a small one) is produced by the delay timebase so the trace will brighten up when the main timebase runs. It is essential to ensure that the main timebase is switched to external trig and that no trig is applied so that it will only trigger off the delay pulse. As the delay pick-off control is turned the bright patch can be seen to move along the trace. When it is at the correct point the scope is switched to "main sweep delayed" and the small portion viewed. If the trace tends to jitter the main timebase controls can be set to trigger from the incoming waveform, if suitable trigger points exist. This eliminates jitter but is not such a flexible method.

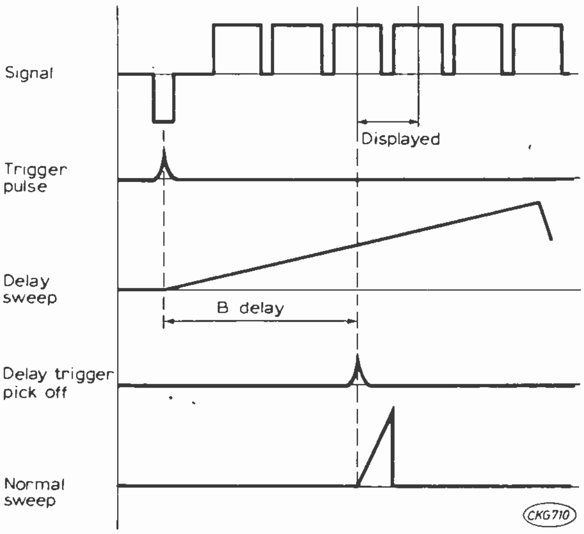


Fig. 6: Sequence of operations in a delay timebase

APPLICATIONS

The most obvious application of these methods is in the viewing of the test pulses inserted in lines 18 and 331 of a TV picture, or to extract the colour bars from the top of the test card. The delay sweep is locked to the field of the receiver and the main sweep set to give about one scan per two lines (150μsec per sweep). Rotation of the delay pick-off pot will enable the user to go through the whole picture line by line. Oscilloscopes that have simple delay circuits are usually arranged to function in this manner but the trace brightness is rather poor, even when 10 or 12kV PDA is used.

Sometimes only a single sweep of the timebase is required, particularly when photographing traces. Most scopes provide for this by making the gating bistable need resetting manually to receive any more trig pulses. The single shot trigger can be provided by an external signal (camera shutter and battery), internally from a transient on the signal or by a button on the front panel. The method of operation varies greatly from one scope to another and so it would be pointless to outline any one method.

CALIBRATION

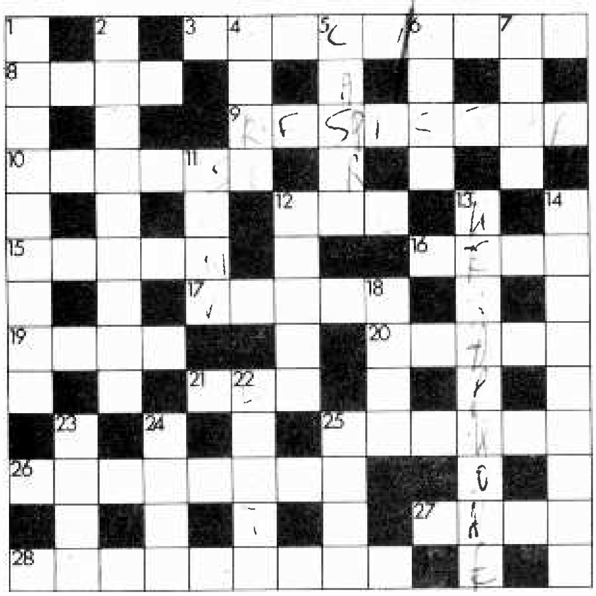
Calibration of a timebase is relatively easy providing a good marker generator is available. However for those who have not got a high accuracy generator a few useful time periods are listed below.

TV frame period	20ms
Main period	·20ms
Line period (405)	98·8μs
Line period (625)	64μs
Radio 2 (1500m/200kHz)	5μs

The gain of the output stage is set so that rotation of the calibration shift moves the spot the required distance. The sweep speeds are then set using a calibrated pulse generator and the sweep speed adjusted so that a rotation of the calibrated shift moves the correct number of markers past a point on the graticule. Calibration is easily achieved to 5% and better is possible. It is perhaps interesting to note that the timebase velocity is given in time/cm, not cm/sec as would be expected. It seems to mean more the first way, which, perhaps, is why it has been retained for so long. At high sweep speeds non-linearity of the trace becomes evident due to bandwidth limitations and often capacitors are provided to linearise the faster ranges, using a high frequency sine wave as the display. General non-linearity of the output stage does not affect calibration of the calibrated shift, but non-linearity arising from bandwidth limitations does cause accuracy to suffer.

To be continued

PW TECHNICROSS PUZZLE No. 5



ACROSS

3 Permanent method for a good set! (5, 4)
8 Lamp worked round open terminal? (4)
9 Opponent of current circuits? (8)
10 Not conscious of such signals? (6)
12 Shortage of a dial system? (3)
15 Reduces the volume of gale-warnings? (5)
16 Drama Marconi's Mum got into? (4)
17 Gives some sort of reception! (5)
19 Swearing about a hot switch? (4)
20 Winners run through such recordings? (5)
21 Member needled over the gramophone? (3)
25 Sound on ears inwardly disconnected! (6)
26 They're driven from the TV chairs! (3, 5)
27 & 1 Down Currently going through with impure stuff? (4, 9)
28 Handy army alternative to radio (9)

DOWN

1 See 27 Across
2 A bouncer needed for TV reception? (9)
4 Sir, a twist to correct distorted melodies! (4)
5 Where to find a radio part on the map? (5)
6 Buzzer used to jam? (4)
7 Old sound transmitter with strings? (4)
11 Metal dish for a separator network? (4)
12 Waste amps with non-electric radio involved? (5)
13 They're designed for individual listeners (9)
14 Press television to cover these? (4, 5)
18 Knock-out in wireless tuning! (4)
22 Range of arc he got into a transformer (5)
23 Appendage of sound equipment (4)
24 Broken bit of a signal from the continent (4)
25 Final receiver of what the employer makes (4)

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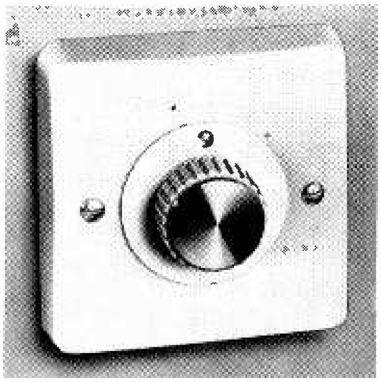

Here's a useful little device—it's a light dimmer (up to 500W) and a photo-electrically operated switch. In addition it serves as a normal on/off switch when required.

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This very versatile unit has a myriad of uses, the first one coming to mind being that of house security. With a Secureye, you can be away on holiday for a fortnight but because your house lights are automatically switched on and off, would-be burglars would think twice before "doing a job".

Price is £5·60 plus VAT. *Rendar Instruments Ltd., Victoria Road, Burgess Hill, Sussex.*

STORAGE BOX

I'm afraid I'm one of those constructors who keeps all his components in odd tins, jars and plastic aerosol can lids and gets in a muddle whenever he wants to find a 56kΩ resistor in a hurry.

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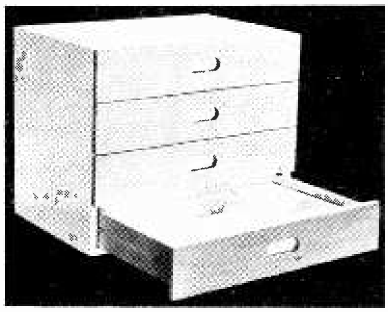
Also available is a matching cupboard and an open unit. They can all be interlocked to form a stacked group arrangement.

The firm supply plastic divider trays and 35mm photographic slide racks taking 180 slides per drawer. These are extras and prices may be obtained from Protocraft.



Rec. prices are: £12·65 for the drawer unit (illustrated) £8·23 for the cupboard and £5·87 for the open unit.

Further gen. from *Protocraft Products Ltd., 3 Blatchford Road, Horsham, Sussex, RH13 5QR.*

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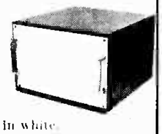

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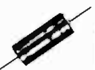

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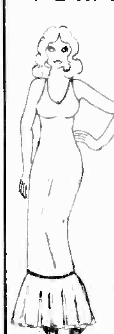

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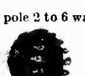

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BROADCAST BANDS

SHORT WAVE DX
by MALCOLM CONNAH

RADIO New Zealand has been heard by our reader **John Godwin** of Rugeley in Staffordshire. John says this in a letter which arrived just too late for inclusion in the last article.

He reports that the best frequency for reception is 11780kHz; he hears the station just after he gets up in the morning (about 0715 GMT) until about 0800 GMT. John suggests the following method of locating the station: First he looks for Radio Australia on the 25 metre band; the strength of this signal being a good pointer to the possibility of receiving New Zealand; then he tunes very carefully up in frequency, about 20kHz, to find Radio New Zealand.

The equipment used was a pre-war HRO and a Joystick antenna. John reports March as being the best month for reception so we will probably have to wait until next year for another chance to hear this elusive station.

Readers' Logs

Strangely enough the first report for this month also includes a logging of New Zealand. The report in question comes from **A. McIntee** of Angus in Scotland who used a 120 foot long-wire antenna with a choice of three receivers; Philips 7 transistor, Codar Multi-band 6, Homebrew crystal set with transistor amplifier; to hear the following:

4985 R. Kiev noted at 1950.
6020 R. Kiev noted at 1930.
6180 BBC relay Cyprus on at 1900.
7215 AIR, Delhi noted at 1918.
11780 R. New Zealand noted at 0700.

Trevor Enefer of Cleethorpes has been concentrating on the lower frequency bands where his Lafayette HA600 and 50 foot end-fed antenna produced the following results:

3250 SABC, South Africa in English at 2315.
4820 HRVC, Honduras in English at 0330.
4820 R. Gambia in English at 2300.
4832 R. Reloj, Costa Rica noted at 0140.
4845 R. Fides, Bolivia. Ident. at 2235.
4845 R. Bucaramanga, Colombia noted at 0340.
4875 SABC, South Africa in Afrikaans at 0400.
4880 R. Universo, Venezuela noted at 03555.
4885 Ondas del Meta, Colombia at 0400.
4972 5 R. Cameroon, Ident. in French at 2215.
4980 Ejura, Ghana in English at 2245.
4990 R. Nigeria, S/off in English at 2305.
5038 R. diff. Nationale Centrafricaine at 2205.
5047 R. diff. du Togo, Ident. in French at 2255.
6000 R. Inconfidencia, Brazil noted at 0130.
6006 R. Reloj, Costa Rica noted at 0140.

Paul Broadhurst of Clevedon in the new county of Avon has added a Codar PR40 preselector to his Trio 9R-59DS, this set-up plus a 150 foot long-wire and two half wave dipoles produced the following:

6050 RAI, Italy with S/on at 2030.
6065 R. Sweden with S/on at 1600.
6160 WYFR, Family Radio noted at 2250.
6165 R. Kiev noted at 1945.
9545 Radio Accra, Ghana noted at 2215.
9550 R. Finland noted at 2046.
9735 VOA, Monrovia, Liberia at 2120.
9745 Radio Baghdad, Iraq noted at 2200.
11765 Radio Australia noted at 0800.
11880 Voice of Turkey, S/on at 2200.
15120 Voice of Nigeria noted at 1620.
15140 Radio Havana, Cuba noted at 2030.
15185 WINB, Red Lion noted at 2115.
15275 TWR, Bonaire at 2140.
15300 HCJB, Quito, Ecuador noted at 2010.
15325 Radio Canada International at 2100.

Stephen Fletcher of Bromsgrove, Worcestershire has a homebrew Heathkit SW717 with a 60 foot end-fed and a 150 wire in the loft. A Grundig Yacht Boy with internal 4 foot telescopic was also available during the compilation of the log:

6080 HCJB, Quito, Ecuador in English at 0930.
6130 R. Norway, news in Norwegian at 1100.
6160 R. Australia in English at 1459.
9525 RSA, South Africa in English 2253.
9670 Adventist World Radio, Portugal at 0845.
9770 VOA relay in Greece, English at 0729.
11740 R. Nederland via Malagasy relay at 1909.
11860 BBC, Ascencion Is. relay in English at 0730.
15012 Voice of Vietnam, news in English at 2124.
15165 R. Denmark in Danish at 1158.
15410 United Nations Radio at 1800.
15415 R. Kuwait in English at 1735.
17830 R. Pakistan in English at 0735.

The final report for this month comes from **Albert E. Ord** of South Shields who used his Trio 9R-59DS with a Joystick and Hamgear Preselector to hear:

4975 R. San Topez, Peru in Spanish at 0200.
4990 R. Barquisimeto, Ven. in Sp. at 0130.
7235 R. Australia noted at 2115.
11670 R. Pakistan in Hindu at 1315.
15185 R. Finland in English at 2030.
21520 RSA, South Africa in English at 1030.

MEDIUM WAVE BROADCASTS by CHARLES MOLLOY

INDEPENDENT Local Radio came to Manchester on April 2nd when Piccadilly Radio appeared on 1151kHz (261m) medium waves and 97MHz v.h.f. A press notice from IBA gives details of the medium wave outlet which is located at Ashton Moss, three miles south of Oldham. A directional aerial consisting of four 235ft masts beams an effective radiated power of 4kW towards Manchester and away from Glasgow, Birmingham and London where the same frequency is alloted to independent local radio. Programmes from Manchester are on the air daily from 0500hrs (0600hrs on Sunday) until 0200hrs.

Roy Patrick (Derby) has been listening to Africa on the medium and long waves with his National 1400 receiver. Three Algerians were heard—Tipaza on 252kHz (1195m) in French during the daytime; Ain Beida on 533kHz and Cran on 548kHz, both in Arabic. From West Africa, Dakar in Senegal was logged on 746kHz at 2325hrs and Conakry, Guinea on 1403kHz after 2300hrs. Roy reports hearing the BBC Eastern Mediterranean relay station in Cyprus relaying the BBC World Service on 1322kHz at 2300hrs GMT. A number of medium wave outlets in Africa are audible in this country after dark. On the long waves listen on 209kHz (1435m) for Arabic music from Azilal in Morocco while on the medium waves Bissau, Portuguese Guinea on 1070kHz can be heard after 2300hrs GMT, usually with pop music. Others to look for are:— Tenerife, Canary Islands in Spanish on 620kHz; Djedeida, Tunisia on 629kHz; El Gawarsha, Libya on 674kHz; Radio Kinshasa, Zaire on 629kHz; Radio Algiers on 890kHz; Tunis on 962kHz; Algiers on 980kHz; El Peida, Libya on 1124kHz and Radio Tangiers on 1232kHz.

Local Radio enthusiast **Stephen Fletcher** (Bromsgrove, Worcs) reports hearing BBC Radio Derby on 1115kHz; BBC Radio Oxford on 1484kHz and BBC Radio Bristol on 1546kHz, using his Grundig Yacht Boy portable receiver. Roy Patrick has heard Radio Clyde on 1151kHz after the close down of Radio Birmingham which operates on the same channel. Local radio is now well established on the medium waves with BBC stations operating on 755kHz (397m); 854kHz (351m); 998kHz (301m); 1034kHz (290m); 1106kHz (271m); 1115kHz (269m); 1457kHz (206m); 1484kHz (202m); 1502kHz (199m); 1520kHz (197m); 1546kHz (194m) and 1594kHz (188m). IBA stations are found on 557kHz (538m); 719kHz (417m).

Ioan ab Elfed (Worcester) is a recent 'convert' to the medium waves. He has built a MW loop aerial and he would now like to join a DX club that caters for the MW Dxer as well as the short wave enthusiast. The World Wide DX Club, Postfach 1263, D-6380 Bad Homburg. West Germany has a useful medium wave section in its monthly DX Magazine and the Danish SW Club International, DK-8382 Hinnerup, Denmark publishes Short Wave News monthly which caters adequately for DXers with an interest in the long and medium wave bands. Each club has a large international membership and their bulletins are printed in English.

Robert Bonsall (Buxton) would like information about an aerial suitable for MW Dxing. The MW loop is the aerial favoured by the majority of medium wave DXers. An article giving constructional details appeared in the April 1973 *Practical Wireless.*

VHF/FM DXING by SIMON DAVID

ONE of the aspects of f.m. DXing is that you may be lucky to get a long distance transmission (or "skip" as it is called) for about ten minutes, then never hear it again. It could quite easily come in on what seems to be the wrong frequency. For example it has been known for "communist bloc" countries, who normally broadcast sound only in the 70MHz region and television sound in the 85 to 92MHz and 93 to 100MHz bands, to break through with short skips into the UK, although it is rare. However, the GDR uses the same f.m. band as the UK and should not be confused with Poland and Hungary who are on the 66 to 72MHz band.

For the readers who have reported to me of frustrated attempts, my advice is don't give up. Earlier advice on aerials and the use of modern highly sensitive receivers will help you. If the "local" station only about 100 miles away seems tame to you, it is a start and with perseverence you will improve. If you run a portable, as so many do, take it up to some high open ground, such as the hills in Wales, Sussex, the Midlands, and Yorkshire. Take some sort of portable three- or four-element aerial that you can rig up temporarily on a telescopic mast.

It is amazing how many people will happily pay £25 to £30 for a tuner or receiver and begrudge £7 or £8 for a good aerial. Without it you cannot expect reliable results, especially if you want stereo.

A useful tip comes from **David Jack** of Bolton who has been DXing from 30 miles west of the Pennines. He suggests cutting out the Atlantic weather chart from the daily paper and sticking it in your log or desk diary. Trends can be followed and rough forecasts made. He has built the Gemini tuner and has picked up Norddeutscher Rundfunk (West Germany) on 99·8MHz and Roermond (Holland) on 88·2MHz on 8th and 9th April.

My thanks to all the other readers who have asked about matters related to this article, including **Stephen Fletcher** of Bromsgrove, **Michael Suttle** of Kilmacanogue, Ireland, **P. Shaw** of Sandbach. Unfortunately, I cannot send out details or recommendations for particular receivers as there are so many. Many of you are unsure of the stations you hear and unable to identify them. It does help if you can recognise the language; have a copy of the World Radio and TV Handbook at your elbow, or even a cassette recorder ready to go when something strange comes through. If you have any doubts and can record what you hear on a cassette, I will try to help you identify the source; of course there should be some speech. The R.S.G.B. reports propagation conditions on Sunday mornings starting at 9.30 (local time) on 3·6MHz. The first station in the south-east is GB2RS and repeats are made in other regions at half-hour intervals. These news bulletins cover many aspects of amateur radio and are broadcast on s.s.b. transmission.

There is a chart available that gives a summary of most of the British and European f.m. stations on the 87·5 to 103MHz band, that are likely to be picked up over long distances. It is a very useful quick reference, especially if reception conditions are changing rapidly. Any reader who would like one should write to me personally and enclose a 25p postal order to cover the cost of printing and postage.

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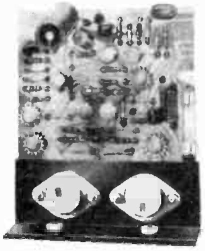

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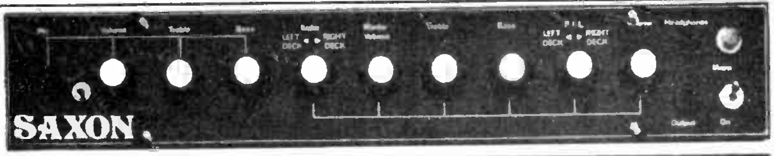

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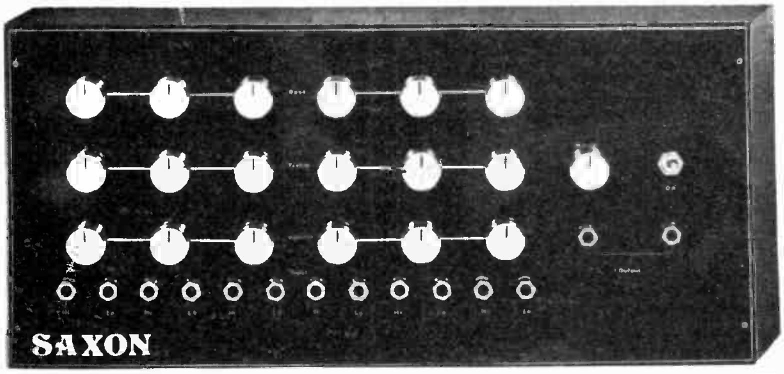

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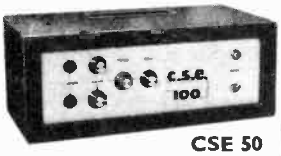

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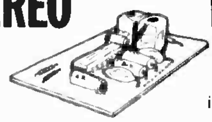

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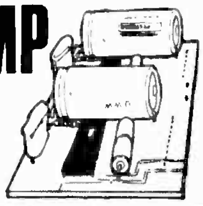

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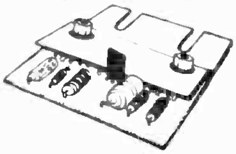

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1500μF	18p	2000μF	43p	470μF	19p
2200μF	18p			680μF	25p
3300μF	26p	**25 VOLT**		1000μF	25p
		10μF	6½p	2200μF	44p
10 VOLT		22μF	6½p		
47μF	6½p	47μF	6½p	**63 VOLT**	
100μF	6½p	100μF	8p	1μF	6½p
220μF	8p	150μF	8p	2·2μF	6½p
330μF	10p	220μF	10p	4·7μF	6½p
470μF	10p	470μF	13p	6·8μF	6½p
1000μF	11p	680μF	20p	10μF	6½p
1500μF	20p	1000μF	22p	22μF	6½p
2200μF	24p	2200μF	39p	68μF	10p
		5000μF	68p	100μF	11p
16 VOLT				150μF	13p
15μF	6½p	**40 VOLT**		220μF	19p
33μF	6½p	6·8μF	6½p	330μF	22p
150μF	6½p	15μF	6½p	470μF	26p
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ON THE AIR

by Eric Dowdeswell G4AR

DELAYS in the publication of Practical Wireless, for reasons beyond editorial control, make it a toss-up as to whether items of news included herein may be out of date by the time that you read this page.

It is hoped that most of you will be aware of the RSGB's annual National Field Day, an old and revered HF bands CW contest, when Clubs put their crack operators to work and actually invite families and friends to go along and watch (and cook and wash up, usually!). If you're not actually taking part then sit down at home and listen in to the lads working worldwide DX on CW with just 10W input. It's the better-than-at-home aerials out in the country that do the trick. Note the date, June 8/9.

Incidentally, if your listening times generally are rather limited in number then try to make them coincide with a contest, then you will be assured of some activity. There is nothing more annoying than to arrange to spend an hour on the receiver only to find that the band is seemingly dead when, in fact, it is just simply lack of activity. International contests such as those organised by the RSGB, ARRL and CQ Magazine brings to life all kinds of rare stations and countries seldom heard normally. So if you are interested in lengthening your 'countries heard' list then this is the time to do it. I once worked 99 different countries in a week-end CW contest and still have the flattened ears to prove it!

When G9ZZZ down the road is working the DX see if you can hear these stations as well. If you can't then there is something wrong, unless he is using an elaborate aerial at 60 feet against your few yards of wire in the loft.

SSTV on 80m

The MPT's decision to permit UK amateurs to use SSTV on 80m has not met with much enthusiasm judging by the rude remarks heard so far from the usual inhabitants of the band. It remains to be seen whether SSTV will be a workable proposition amid all the other noises on the band. Personally I doubt it, except for perhaps local working where the strong signals may override interference, deliberate and otherwise! Somehow I don't think that SSTV and SSB are going to mix in the few kHz at the top end of the band.

Our amateurs can often be heard airing their views on non-amateur noises on 80m but they seem to forget that this is a shared band here and that a lovely S9 signal from some DX station is equally just a noise to some other service sharing the band.

Goodbye MPT!

Not many amateurs seem to be aware yet of the intention of the present Government to abolish the Ministry of Posts and Telecommunications. Among other responsibilities the Home Office will administer the Wireless Telegraphy Acts which are of immediate concern to amateurs here. The MPT, or whatever it was called at different times in the past, has always had a very close and amicable relationship with the amateur, mainly through the good offices of the RSGB, and it is to be hoped that this happy state of affairs will long continue. It will not profit our movement if we have to deal with faceless Civil Servants knowing nothing of our hobby.

In spite of the scarcity of sunspots the HF bands are improving generally with the increasing hours of daylight which we are now enjoying. Except, of course, that it generally means a transfer of personal activity at home from the inside to the outside! So when you are ostensibly doing a bit of weeding or shooing the birds from the seedlings why not shove up a rhombic aerial or at least a nice long wire as high as possible. With copper being so pricey these days don't overlook the possibility of using aluminium wire as a substitute, preferably hard drawn to avoid stretch.

GB2MT

The Marconi Centenary station GB2MT, operated by Ralph Barrett G2FQS, and mentioned last month, managed 235 QSO's on SSB from Marconi's old home in Bayswater, London. Unfortunately, on the great day itself, April 25th, no contact was made with II4FGM, the Italian counterpart of GB2MT, located in the mausoleum where Marconi now rests. This was in spite of a schedule and a reminder by Telex from the Marconi Company here. Plenty of other Italian stations were worked around the same time. It is understood that II4FGM will be active for the rest of the year but only on Saturday afternoons.

Apologies again for the lack of any reports from readers, which would normally form the backbone of this page. My appeal in the last issue for reports will not produce any response in time for this month's page because of the delayed publication dates. Once things get back to normal, hopefully with the July issue, it will be possible to raise matters in one issue and to deal with them in the next, said he, optimistically!

BROADCAST BANDS

Short Wave Reports by 15th of the month to Malcolm Connah, 27 Lismore Road, Highworth, Swindon, Wiltshire, SN6 7HU.

Medium Wave Logs to Charles Molloy, 132 Segars Lane, Southport, PR8 3JG.

VHF/FM Reports to Simon David, c/o Practical Wireless, Fleetway House, Farringdon Street, London, EC4A 4AD.

AMATEUR BANDS

Logs covering any amateur band/s in band/alphabetical order by the middle of the month to **Eric Dowdeswell G4AR, Silver Firs, Leatherhead Road, Ashtead, Surrey, KT21 2TW.**

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~~BFX 19~~	~~25~~	~~210 MHz~~	~~10p~~
~~2N 2906~~	~~60~~	~~200 MHz~~	~~15p~~
~~2N 3702~~	~~40~~	~~100 MHz~~	~~11p~~
~~2N 3703~~	~~50~~	~~100 MHz~~	~~12p~~

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BC 108	30	150 MHz	15p
BC 109	30	150 MHz	15p
BF 179	225	125 MHz	40p
BF 180	30	625 MHz	25p
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BFX 43	30	500 MHz	20p
BFX 86	40	50 MHz	17p
BFY 53	30	50 MHz	10p
2N 607	60	40 MHz	12p
2N 709	15	900 MHz	30p
2N 718	60	60 MHz	12p
2N 753	25	250 MHz	12p
2N 744	20	300 MHz	12p
2N 1613	75	60 MHz	17p
2N 2220	60	250 MHz	15p

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Type	Voltage	Frequency	Price
ACY 44	50	1 MHz	10p
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AF 124	20	75 MHz	20p
AFY 19	32	350 MHz	20p
ASY 32	25	5 MHz	10p
ASZ 21	15	450 MHz	20p
GET 113	32		10p
GET 120	32	2 watts	10p
OC 123	50	1 MHz	10p
OCP 70	Light-sensitive		20p
2N 1307	30	10 MHz	15p
2N 1309	30	15 MHz	15p
2N 448	60	150 watts	£1

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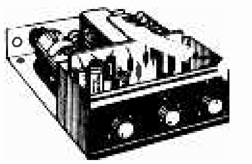

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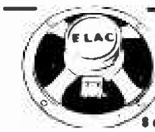

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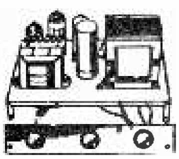

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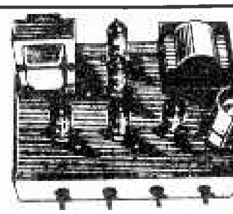

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F. M. Multiplex Stereo Decoder	MC1310P	2.93
Four Channel SQ Decoder	MC1312P	1.75
O/P Power Transistor	2N3055	0.65

SIGNETICS		
I/C Timer	NE555V	0.80
Dual I/C Timer	NE556A	1.40
High Phased Locked Loop	NE560B	4.20
High Phased Locked Loop with AM Demod	NE561B	4.20
High Phased Locked Loop with Open VCO	NE562B	4.20
Precision Phased Locked Loop	NE565A	2.90
Function Generator	NE566V	1.55
Tone Decoder	NE567V	2.90

G.I.		
Eight Digit Calculator Chip	C500	11.00
Eight Digit Calculator Chip	C550	9.50
3½ Decade DVM Chip	AY-5-3510	6.40

MONSANTO		
(MAN3M) 0.115" LED Seven Segment Display	Q2501	1.10

FERRANTI		
Radio Receiver	ZN414	1.20

Data information supplied with each device.

Write for free catalogue of our large stocks of Ferranti, Motorola, G.I., Monsanto, Mullard, Signetics and R.C.A. components.
Add 20p Postage and Packing + 10% V.A.T. on total of order

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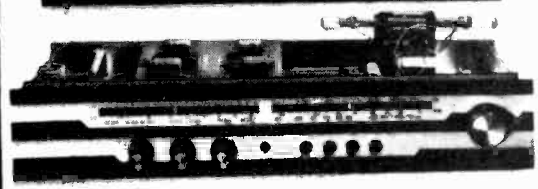
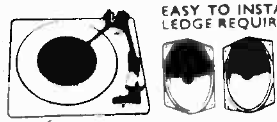
THE AVON AUDIO SYSTEM



The uncabinated system is ideal as an economical replacement for an outdated chassis. Stereo Amplifier for Stereo/Mono record reproduction. Tuner with medium, long and short wavebands provides Worldwide coverage, even the weakest continental stations can be received with superb clarity. Push button band selection, 10 watts total output. Frequency response 25-18000 Hz.

LATEST BSR STEREO/MONO RECORD CHANGER plays all types of 7in., 10in., and 12in. Mono or Stereo records. Manual or automatic play.

TWIN ELLIPTICAL SPEAKERS These low impedance, permanent magnet units have been specially selected to provide the fullest range of audio reproduction.



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This is your opportunity to train as a television and radio engineer on our full-time Two-Year College Diploma Course specially designed to cover the examinations of the City and Guilds Radio, Television and Electronics Technicians' Certificate. Full theoretical and practical instruction on all types of modern receivers—including the latest colour sets.

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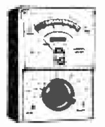
AUDIOTRONIC Model ATM1



Top value 1,000 opv pocket multi-meter. Ranges:– 0/10/50/250/1,000 volt AC and DC. DC current 0-1mA/100mA. Resistence: 0/150k ohms. Decibels: –10 to +22dB. Size 90 x 60 x 28mm. Complete with test leads.

OUR PRICE £3.25 P&P 15p

AUDIOTRONIC Model ATM5

Jewel movement, attractively moulded case with edgwise ohms adjustment. Ranges: 0-3/15/150/300/1200V AC, (2500 opv). 0-6/30/300/600V DC. (5000 opv). 0-300 uA/0-300mA DC. Resistance: x 10 & x 100. –10 to +16dB. Supplied with battery test leads and data booklet. Size: 121 x 73 x 29mm.

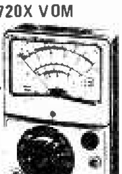
OUR PRICE £3.50 P&P 15p

MODEL TH12

20,000 opv. Overload protection. Slide switch selector. 0/0.25/2.5/10/50/150/1000V DC. 0/10/50/250/1000V AC. 0/50uA/25/250mA DC. 0/3k/30k/300k/3 Megohms. –20 to +50dB.

OUR PRICE £5.95 P&P 15p

HIOKI Model 720X VOM



A versatile, accurate measuring instrument. 20,000 opv. 0/5/25/100/500/1000V DC. 0/10, 50/250/1000V AC. 0–50uA/250mA. 0–20k/2 Megohms.

OUR PRICE £5.97 P&P 20p

MODEL PL436

20,000 opv DC. 8000 opv AC. Mirror scale 6/3/12/30/120/600V DC. 3/30/120/600V DC. 50/600μA/60/600mA. 10/100K/1 Meg/10 Meg Ohm. –20 to 46 dB.

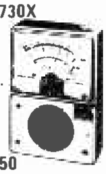
OUR PRICE £6.97 P&P 15p

U4323 MULTIMETER

20,000opv. Simple unit with audio/IF oscillator. Suitable for general receiver tuning. Ranges: 0.5/2.5/10/50/250/500/1000V DC. 2.5/10/15/250/500/1000V AC. 0.05/0.5/5/50/500mA DC. Resistance: x 10. x 100. x 1,000. x 10,000 (50Ω. 500Ω. 5kΩ. 50kΩ centre scale). Battery operated. Size: 160 x 97 x 40mm. Supplied in carrying case complete with test leads.

OUR PRICE £7.00 P&P 20p

MODEL HIOKI 730X



30,000 opv. Overload protection. 6/30/60/300/600/1200V DC. 12/60/120/600/1200V AC. 60/μA/30mA/300mA. 2K/200K/2 Meg Ohm. 10 to 63dB.

OUR PRICE £7.50 P&P 15p.

MODEL TE300

30,000opv. Mirror scale. Overload protection. 0/0.6/3/15/60/300/1200V DC. 0/6/30/120/600/1200V AC. 0/30uA/6mA/60mA/300mA/600mA. 0/8k/80k/800k/8 Meg ohms. –20 to +63dB.

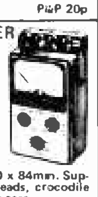
OUR PRICE £7.50 P&P 15p

U4324 MULTIMETER

High sensitivity, overload protected. 20,000opv. Ranges: 0.6/1.2/3/12/30/60/120/600/1200V DC. 3/6/15/60/150/300/600/900V AC. Current: 0.06/0.6/6/60/600mA/3A DC. 0.3/3/30/300mA/3A AC. Resistance: 25/500 ohms/0.5/5/50/500k ohms/5 Mohms. Decibels: –10 to +12dB. Size 167 x 98 x 63mm. Supplied complete with test leads, spare diode and instructions.

OUR PRICE £8.00 P&P 20p

U435 MULTIMETER



20,000opv. Overload protected. Ranges: 75mV/2.5/10/25/100/250/500/1000V DC. 2.5/10/25/100/250/500/1000V AC. Current: 50uA/1/5/25/100mA/0.5/2.5A DC. 5/25/100mA/0.5/2.5A AC. Resistance: 0.3/3/30/300k ohms. Size: 205 x 110 x 84mm. Supplied complete with leads, crocodile clips and steel carrying case.

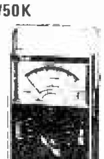
OUR PRICE £8.75 P&P 20p

U91 Clamp VOLT AMMETER

For measuring AC voltage and current without breaking circuit. Ranges: 300/600V AC. Current: 10/25/100/250/500A. Accuracy 4%. Size 283 x 94 x 36mm. Complete with carrying case, leads and fuses.

OUR PRICE £10.50 P&P 20p

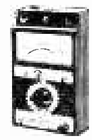
TMK MODEL TW50K



46 ranges, mirror scale. 50k/V DC 50k/V AC. DC Volts: 0.125/0.25/1.25/2.5/5/10/25/50/125/250/500/1000. AC Volts 1.5/3/5/10/25/50/125/250/500/1000. DC current 25/50uA/2.5/5/25/50/250/500mA/5/10A. Resistance: 10k/100k/1 Meg/10 Meg ohms. –20 to +81.5dB.

OUR PRICE £12.50 P&P 17p

U4312 MULTIMETER



extremely sturdy instrument for general electrical use. 667opv. 0/0.3/1.5/7.5/30/60/150/300/600/900V DC & 75mV. 0/0.3/1.5/7.5/30/60/150/300/600/900V AC. 0/300uA/1.5/6/15/150/60/600mA/1/1.5/6A DC. 0/1.5/6/15/60/150/600mA/1.5/6A AC. 0/200/3k/30k ohms. DC accuracy 1%. AC 1.5%. Knife edge pointer, mirror scale. Complete with sturdy metal carrying case, leads and instructions.

OUR PRICE £9.75 P&P 25p

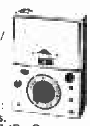
MODEL 500

30,000 opv with overload protection. Mirror scale. 0/0.5/2.5/10/25/100/250/500/1000V DC. 0/2.5/10/25/100/250/500/1000V AC. 0/50uA/5/50/500mA. 12A DC. 0/60k/6 meg/60 megohms.

OUR PRICE £13.95 Carr. paid

Leather case for above £1.75

HIOKI 750X VOLT-OHM-MILLIAMETER



43 ranges: 0–0.3/0.6/1.5/3/6/12/30/60/150/300/600/1,200V DC. 0–3/6/15/30/60/120/300/600/1,200V AC. Current: 0–30/60uA/1.5/3/15/30/150/300mA/6/12A. Resistence: 0–3/300k/3/30Mohms. Decibels: –10 to +17dB. Output:– 0–3/6/15/30/60/120/300V. Accuracy ± 3% DC. ± 4% AC. Sensitivity: 50,000 opv DC. 5,000 opv AC. 4 inch meter. Built in protection. Size: 57 x 102 x 153mm.

OUR PRICE £11.95 P&P 40p

HIOKI MODEL 700X

100,000opv. Overload protection. Mirror scale. 0.3/0.6/1.2/1.5/3/6/12/30/60/120/300/600/1200V DC. 1.5/3/6/12/30/60/150/300/600/1200V AC. 15/30uA/3/6/30/60/150/500mA/6/12A DC. 2k/200k/2M/20MOhms. –20 to +63dB.

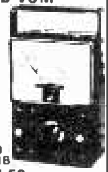
OUR PRICE £14.95 P&P20p

Model HT100B4 MULTIMETER

Overload protected, shock proof circuits. 9.5uA Meter with mirror scale. Sensitivity 100kV. Polarity change switch. Ranges: 0.5/2.5/1-/50/250/500/1,000 Volts DC. 2.5/10/50/250/1,000 Volts AC. DC resistence 0–20/200k/2/20 Meg. ohms. DC current:– 10/250uA/2.5/25/250 mA/10A. AC current:–0–10A. –20 to +62dB. Operates from 2 x 1.5V batteries. Size: 180 x 134 x 79mm.

OUR PRICE £17.50 P&P 40p

MODEL AS.100D VOM



100,000 opv. Mirror scale. Built-in meter protection. 0/3/12/60/120/300/600/1200V DC. 0/6/30/120/300/600V AC. 0/10μA/6/60/300mA/12 Amp. 0/2K/200K/2M/200 Meg Ohm. –20 to +17dB

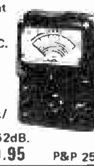
OUR PRICE £17.50 P&P 20p.

TMK 100K LAB TESTER

100,000opv. 6½" scale. Buzzer short circuit check. Sensitivity 100,000 opv DC. 5k/V AC DC Volts: 0.5/2.5/10/50/250/1000V AC. 3/10/50/250/500/1000V DC. current 10/100uA/10/10/100/500mA/2.5/10A. Resistence: 1k/10k/100k/10 Meg/100 Meg ohms. Decibels: –10 to +49dB. Plastic case with carrying handle. Size: 190 x 172 x 99mm.

OUR PRICE £19.95 P&P 25p

370WTR MULTIMETER



Features AC current ranges. 20,000opv. 0/0.5/2.5/10/50/250/500/1000V DC. 0/2.5/10/50/250/500/1000V AC. 0/50uA/1/10/100 mA/1/10A DC. 0/100mA/1/10A AC. 0/5k/50k/500k/5 Meg/50 Meg. Decibels: –20 to +62dB.

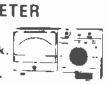
OUR PRICE £19.95 P&P 25p

KAMODEN 72.200 Multitester

High sensitivity tester. 200,000 opv Overload protected. Mirror scale. Ranges:–0/.06/.3/3/30/120/600/1200V DC. 0/3/12/60/300/1200V AC. 0/6uA/1.2mA/120mA/600mA/12A DC 0/12A AC. –20 to +63dB. 0/2k/200k/2 Meg/200 Megohms.

OUR PRICE £22.50 P&P 30p

U4317 MULTIMETER



High sensitivity instrument for field and laboratory work. Knife edge pointer, 86mm. mirror scale. Ranges: 100mV/0.5/2.5/10/25/50/100/250/500/1000V DC. 0.5/2.5/10/25/50/100/250/500/1000V AC. Current: 50uA/0.5/1/5/10/50/250mA/1/5A DC. 0.25/0.5/1/5/10/50/250mA/1/5A AC. Resistance: 0.5/10/100/200 ohms/1/3/30/300k ohms. Decibels: –5 to +10dB. Battery operated. Size: 210 x 115 x 90mm. Supplied in carrying case complete with leads.

OUR PRICE £15.00 P&P 20p

MODEL U4311 Sub-standard Multi-range Volt-Ammeter

Sensitivity 330 Ohms/Volt AC and DC. Accuracy 0.5% DC. 1% AC. Scale length 165mm. 0/300/750uA/1.5/3/7.5/15/30/75/150/300/750mA/1.5/3/7.5A DC. 0/3/7.5/15/30/75/150/300/750mA/1.5/3/7.5A AC. 0/75/150/300/750mV/1.5/3/7.5/15/30/75/150/300/750V DC. 0/750mV/1.5/3 /7.5/15/30/75/150/300/750V AC. Automatic cut out device. Supplied complete with test leads, manual and test certificates.

OUR PRICE £49.00 P&P 50p

TE65 VALVE VOLTMETER

28 ranges. DC volts 1.5–1500V. AC volts 1.5–1500V. Resistance up to 1000 Megohms. 200/240V AC operation. Complete with probe and instructions.

OUR PRICE £17.50 P&P 30p

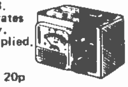
Additional probes available RF £2.12, HV £2.50

MODEL AF.105 VOM

50,000 opv. Mirror scale. Meter protection. 0/3/12/60/120/300/600/1200V DC. 0/6/30/120/300/600/1200V DC. 0/30μA/6/60/300 mA, 12 Amp. 0/10K/1m/10m/100 Meg Ohms. –20 to +17dB.

OUR PRICE £12.50 P&P 20p.

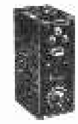
LB3 TRANSISTOR TESTER



Tests ICO and B. PNP/NPN. Operates from 9V battery. Instructions supplied.

OUR PRICE £3.95 P&P 20p

LB4 TRANSISTOR TESTER



Tests PNP or NPN transistors. Audio indication. Operates on two 1.5V batteries. Complete with instructions etc.

OUR PRICE £4.50 P&P 20p

U4341 Multimeter & Transistor Tester

27 ranges. 16,700opv. Overload protected. Ranges: 0.3/1.5/6/30/60/150/300/900V DC. 1.5/7.5/30/150/300/750V AC. Current: 0.06/0.6/6/60/600mA DC. 0.3/3/30/300mA AC. Resistance: 0.06/0.6/2/6/20/60/200k ohms/2 Mohms. Battery operated. Supplied complete with probes, leads and steel carrying case. Size: 115 x 215 x 90mm.

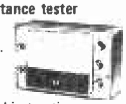
OUR PRICE £10.50 P&P 20p

S100TR MULTIMETER TRANSISTOR TESTER

100,000opv. Mirror scale. Overload protection. 0/0.12/0.6/3/12/30/120/600V DC. 0/6/30/120/600V AC. 0/12/600uA/12/300mA/6/12A DC 0/10k/1 Meg/100 Meg. –20 to +50dB. 0.01–0.2MFD. Transistor tester measures Alpha, Beta and ICO. Complete with instructions, batteries and leads.

OUR PRICE £19.95 P&P 25p

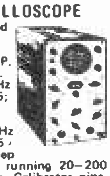
KAMODEN HMG500 insulation resistance tester



Range 0–1,000 Megohms, 500V. Battery operated. Wide range clear meter 4"x4¾". Complete with deluxe carrying case, batteries and instructions.

OUR PRICE £19.95 P&P 30p

C15 PULSE OSCILLOSCOPE



For display of pulsed and periodic waveforms in electronic circuits. VERT. AMP. Bandwidth: 10MHz. Sensitivity at 100kHz VRMS/mm: 0.1–25; HOR. AMP. Bandwidth: 500kHz. Sensitivity ay 100kHz VRMS/mm: 0.3–25. Preset triggered sweep 1–3000usec. Free running 20–200 kHz in nine ranges. Calibrator pips. 220 x 360 x 430mm. 115–230V AC.

OUR PRICE £39.00 Carr. paid

RUSSIAN C116 Double Beam OSCILLOSCOPE

5 MHz pass band. Separate Y1 and Y2 amplifiers. Rectangular 5" x 4" CRT. Calibrated triggered sweep from 0.2usec. to 100 milli-sec/cm. Free running time base, 50Hz–1MHz. Built-in time base Calibrator and amplitude Calibrator. Supplied complete with all accessories and instruction manual.

OUR PRICE £87.00 Carr. paid

MODEL TE15 GRID DIP METER

Transistorised. Operates as Grid Dip, Oscillator, Absorbtion Wave Meter and Oscillating Detector. Frequency range 440kHz–280MHz in six coils. 500uA meter. 9V battery operation. Size: 180 x 80 x 40mm.

OUR PRICE £19.95 P&P 20p

Also see following pages

ALL PRICES EXCLUDE VAT

SWR METER Model SWR3

Handy SWR meter for transmitter antenna alignment, with built-in field strength meter. Accuracy 5%, Impedence 52' Indicator 100uA DC. Full scale 5 section collapsible antenna. Size 145 x 50 x 60mm.

OUR PRICE £4.25 P&P 25p

AT201 Decade ATTENUATOR

Frequency range 0–200kHz. Attenuato. 0–111dB, 0.1dB steps. Impedence 600 ohms. Input power maximum 30dBm. Size: 180 x 90 x 55mm.

OUR PRICE £12.50 P&P 37p

TRANSISTORISED L.C.R. A.C. BR/8 MEASURING BRIDGE

A new portable bridge offering excellent range and accuracy at low cost. Resistance: 6 ranges: 0.1 ohm-11.1 megohm ± 1% Inductance: 6 ranges: 1 microhenry-111 henries ± 2% Capacity: 6 ranges: 10pf-1110 mfd ± 2% Turns Ratio: 6 ranges: 1:1/1000-1:11100 ± 1% Bridge Voltage at 1,000cps. Operated from 9-volt battery. 100 microamp meter indication. Size 7¼" x 5" x 2"

OUR PRICE £25.00 P&P 25p

TE16A TRANSISTORISED SIGNAL GENERATOR

5 ranges, 400kHz to 30MHz. An inexpensive instrument for the handy-man. Operates on 9V battery. Wide easy to read scale. 800kHz modulation. Size: 149 x 149 x 92mm. Complete with instructions and leads.

OUR PRICE £8.97 P&P 25p

MODEL TE20 RF SIGNAL GENERATOR

Six bands. 120kHz–260MHz. Dual output RF terminals. Separate variable audio output. Accuracy ± 2%. Audio output to 8V. Power requirements: 105–125V, 220–240V AC. Size: 193 x 265 x 150mm. Complete with test leads etc.

OUR PRICE £17.50 P&P 40p

TE-200 RF SIGNAL GENERATOR

Accurate wide range signal generator covering 120 kHz-500 MHz on 6 bands. Directly calibrated. Variable R.F. attenuator audio output. Xtal socket for calibration. 220/240V a.c. Brand new with instructions. Size 140mm x 215mm x 170mm.

OUR PRICE £17.50 P&P 30p.

TE22 SINE SQUARE WAVE AUDIO GENERATOR

Sine 20cps to 200kHz on 4 bands. Square 20 cps to 30 kHz. Output impedence 5000 Ohms. 200/250V AC operation. Supplied brand new guaranteed, with instruction manual and leads.

OUR PRICE £24.95 P&P 37p

ARF 300 AF/RF SIGNAL GENERATOR

All transistorised compact fully portable. AF sine-wave 18Hz to 220 kHz. AF square wave 18Hz to 100k Hz. Output Square/Sine wave 10V. P-P RF 100kHz to 200MHz. Output 1V maximum. 220/240V AC operation. Complete with instructions and leads.

OUR PRICE £37.50 P&P 50p

Also see previous page

MODEL MG100 SINE SQUARE WAVE AUDIO GENERATOR

Range 19-220,000Hz Sine Wave 19—100,000 Hz Square Wave Output Sine or Square wave 10v P to P Size 180 x 90 x 90mm. Operation 220/240v. A.C

OUR PRICE £19.95 P&P 37p

PS200 Regulated POWER SUPPLY UNIT

Solid state. Variable output 5–20V DC up to 2 Amp. Independent meters to monitor voltage and current. Output 220/240V AC. Size: 190 x 136 x 98mm.

OUR PRICE £19.95 P&P 25p

POWER RHEOSTATS

High quality ceramic construction. Windings embedded in vitreous enamel. Heavy duty brush wiper. Continuous rating. Wide range available ex-stock. Single hole fixing. ¼" diameter shafts. Bulk quantities available.

25 WATT 10/50/100/250/500/1000 Ohms £1.15 P&P 10p

50 WATT 10/25/50/250/500/1000/2500/5000 Ohms. £1.62 P&P 10p

100 WATT 1/10/25/50/100/250/500/1000/2500 Ohms £2.34 P&P 15p

YAMABISHI VARIABLE VOLTAGE TRANSFORMERS

Excellent quality at low cost. Input: 230V 50/60Hz. Output 0–260V.

MODEL S260 BENCH MOUNTING

		P&P
1A	£10.50	30p
2.5A	£12.00	35p
5A	£17.50	37p
8A	£30.35	50p
10A	£33.75	75p
12A	£29.50	75p
20A	£85.00	125p
25A	£95.00	130p
40A	£120.00	150p

MODEL S260B PANEL MOUNTING

1A	£10.00	30p
2.5A	£12.00	35p

BV05 Vernier TUNING DIAL

App. 7:1 ratio planetary drive vernier dial. Log scale 0–180 degrees. Blank scales 1–5. Dial size 128 x 76mm. Overall size 190 x 117 x 41mm. deep including knob and coupling. ¼" diam. shaft

OUR PRICE £1.62 P&P 15p

240° Wide Angle 1mA METERS

MW 1–6 60x60mm £6.50 P&P 15p

MW 1–8 80x80mm £6.90 P&P 15p

CP110 CHASSIS PUNCH SET

Carefully machined top grade steel. Contains 1/2", 5/8", 3/4", 1" and 1 1/8" punches complete with gripper and accessories.

OUR PRICE £3.00 P&P 40p

HITACHI FLUORESCENT LANTERN L1901

A portable battery operated lantern ideal for home, motoring, camping etc. Approx. 10" tall. Provides brilliant light from 9 1.5v batteries (not supplied).

OUR PRICE £7.19 P&P 25p.

KE630 3 Station INTERCOM

Master and two sub-stations. Can be used on desk or wall mounted. Complete with cable and batteries

OUR PRICE £5.25 P&P 50p

WALKIE TALKIES

LIMITED STOCKS

SKYFON 100mW

OUR PRICE £24.95 per pair

P302 Two Channel 300mW

OUR PRICE £52.50 per pair

P1003 Three Channel 1 Watt

OUR PRICE £71.25 per pair

P&P 50p per pair

N.B. Unlicenceable in U.K.

OT55G DIGITAL CLOCK MECHANISM

Features 24 hour alarm setting, on/off and auto alarm 'sleep' switch. Illuminated rotary dial with hours, minutes and seconds. Automatically turns off radio, TV, light etc. and with auto-switching will turn on again when required. 240V AC operation. Switch rating 250V–3 Amp.

OUR PRICE £5.95 P&P 30p

SINCLAIR IC12 INTEGRATED CIRCUIT AMPLIFIER

complete with printed circuit mounting board.

OUR PRICE £2.35 P & P 15p.

LH02S STEREO HEADPHONES

Light weight headphones with padded ear pieces. 4/16 ohms 20–20,000Hz. Complete with 6' lead and plug.

OUR PRICE £1.97 P&P 30p

TE1018 Deluxe Mono High Impedence Headset.

Sensitive magnetic headset with soft ear pads. Impedence 2,600 ohms (600 ohms DC). Frequency response: 200–4,000Hz.

OUR PRICE £2.25 P&P 30p

TE1035 Stereo HEADPHONES

Low cost with excellent response. Foam rubber earcups. Adjustable headband. 8 ohms impedence. Frequency response 25Hz–18kHz. Complete with cable and stereo jack plug.

OUR PRICE £2.60 P&P 30p

SH80V MONO/STEREO HEADPHONES

Volume control for each channel. 4/16 ohms impedence. Frequency response 20Hz–18kHz. Complete with 10ft. coiled lead and jack plug.

OUR PRICE £4.97 P&P 30p

BH001 HEADSET and Boom Microphone

Moving coil. Ideal for language teaching, communications etc. Headphone impedance 16 ohms. Microphone impedence 200 ohms.

OUR PRICE £5.95 P&P 30p

EMI LOUDSPEAKERS

Model 350 13 x 8" with single tweeter/crossover. 20–20,000Hz. 15 watts RMS. Available 8 or 15 ohms.

OUR PRICE £7.50 each P&P 37p

Model 450 13 x 8" with twin tweeter/crossover. 55–13,000Hz. 8 watts RMS. Available 8 or 15 ohms

OUR PRICE £3.62 each P&P 25p

SPECIAL PURCHASE LIMITED QUANTITY! Tannoy 12" DR/8 Bass Speakers

8 ohms 30 watt Heavy duty, ideal for Hi-Fi P.A. Group

OUR PRICE £12 50 P&P 50p

SPECIAL BARGAIN! FERGUSON 3406 HI-FI SPEAKERS

High quality 2 way speaker systems. 25 Watts. 4–8 ohms. 40Hz–18kHz. Size: 560 x 340 x 255mm. approx. Wood grain finish with black fronts.

OUR PRICE £26.95 PR. P&P £1

SPECIAL BARGAIN !! STEREOSOUND SPEAKERS

Matched pair of stereo bookshelf speakers. Deluxe teak veneered finish. Size: 368 x 229 x 190mm, 8 ohms. 8 watts RMS, 16 watts peak. Complete with Din lead.

OUR PRICE £12.95 P&P 50p

FM TUNER CHASSIS

6 transistor high quality tuner. Size only 153 x 101 x 63mm 3 IF stages. Double tuned discriminator. Ample output to feed most amplifiers. Operates on 9V battery. Covers 88–108MHz. Ready built, ready for use. Fantastic value for money.

OUR PRICE £8.95 P&P 20p

Stereo Multiplex Adaptor £5 95 extra

Model A1018 FM TUNER

6 transistor high quality unit—3 IF stages and double tuned discriminator. For use with most amplifiers. Covers 88–108MHz. Powered by 9V battery.

OUR PRICE £13.50 P&P 30p

Stereo multiplex adapter £5.95 extra.

SINCLAIR "SCIENTIFIC" CALCULATOR

8 digit display Four functions plus logarithms to base 10, antilog, sine, cosine, tangent, arcSine, arcCosine and arcTangent Complete with instructions, case and batteries Rec Price £49.00

OUR PRICE £44.50 P & P 25p plus VAT.

SINCLAIR SYSTEM 2000 STEREO AMPLIFIER AND TUNER

AMPLIFIER

Amplifier output 8 watts per channel RMS. Distortion less than 0 06%. Silicon transistors Two pick-up plus radio and tape inputs, tape output and scratch filter. Excellent Value

OUR PRICE £28.50 P & P 60p.

FM TUNER

Excellent selectivity and sensitivity. Twin dual-varicap tuning. 4 pole ceramic filter 19 transistor stereo demodulator giving 40 dB separation Distortion 0 2% output. Fantastic Value.

OUR PRICE £28.50 P & P 60p

SINCLAIR Project 80 Modules

Z40 Power Amplifier	£5.45
Z60 Power Amplifier	£6.95
Stereo 80 Pre-Amplifier	£11.95
Active Filter Unit	£6.95
Project 805	£26.95
PZ5 Power Supply	£4.98
PZ6 Power Supply	£7.98
PZ8 Power Supply	£7.98
Transformer for PZ8	£4.05

SINCLAIR Project 80 Packages

2 x Z40/Stereo 80/PZ5	£25.00
2 x Z40/Stereo 80/PZ6	£27.75
2 x Z60/Stereo 80/PZ8	£30.45

POST & PACKING 35p each.

MP7 MIXER-PREAMPLIFIER

5 Microphone inputs each with individual gain controls enabling complete mixing facilities. Battery operated. Size: 235 x 127 x 76mm. Inputs: Mics. 3 x 3mV 50k; 2 x 3mV 600 ohms. Phono. Mag. 4mV 50k; Phono Ceramic 100mV 1 Meg. Output 250mV 100k.

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HIGH QUALITY CONSTRUCTION KITS

JOSTY KIT

WE ARE APPOINTED STOCKISTS AT ALL BRANCHES

All kits are complete with comprehensive easy to follow instructions and covered by full guarantee.

Post and Packing 15p per kit.

AF20 Mono amplifier	£4.80
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AF30 Mono pre-amplifier	£2.61
AF35 Emitter amplifier	£2.27
AF80 0.5W mic. amplifier	£4.22
AF305 Intercom	£9.52
AF310 Mono amplifier	£5.91
AT5 Automatic light control	£2.58
AT25 Window wiper robot	£5.82
AT30 Photo cell switch unit	£5.70
AT50 400W triac light dimmer/speed control	£4.80
AT56 2,200W triac light dimmer/speed control	£6.90
AT60 1 channel light control	£7.80
AT65 3 channel light control	£14.55
GP304 Circuit board	£4.94
GP310 Stereo pre-amplifier for use with 2 x AF310	£21.27
GP312 Circuit board	£11.45
GU330 Tremolo unit	£7.50
HF61 Diode detector	£3.32
HF65 FM transmitter	£2.70
HF75 FM receiver	£2.87
HF310 FM tuner	£15.81
HF325 Deluxe FM tuner	£24.12
HF330 Decoder (HF310/325)	£9.96
HF380 lw/vhf aerial amplifier	£4.94
HF395 broadband aerial amp.	£1.77
LF380 Quadraphonic device	£11.36
M160 Multi-vibrator	£1.71
M191 VU Meter	£4.55
M192 Stereo balance meter	£4.97
M1302 Transistor tester	£8.45
NT10 Stabilised power supply 100mA, 9V	£6.15
NT300 Stabilised p. supply	£12.51
NT305 Voltage converter	£4.50
NT315 Power supply 240V AC to4,5/15V DC, 500mA	£9.57

Amateur Electronics by Josty-Kit, the professional book for the amateur —covers the subject from basic principals to advanced electronic techniques. Complete with circuit board for AE1 to AE10 listed below.

OUR PRICE £3.30 (No VAT) P&P 25p plus VAT.

AE1 100mW output stage	£1.50
AE2 Pre-amplifier	£1.15
AE3 Diode receiver	£1.82
AE4 Flasher	99p
AE5 Astable multi-vibrator	95p
AE6 Monostable multi-vibrator	93p
AE7 RC generator	97p
AE8 Bass filter	90p
AE9 Treble filter	90p
AE10 CCIR filter	90p

1021 Stereo Listening Station

For balancing and gain selection of loudspeakers with additional facility for stereo headphone switching. Two gain controls, speakers on–off slide switch, stereo headphone socket.

OUR PRICE £2.25 P&P 15p

AUDIOTRONIC LOW NOISE CASSETTES

TYPE	5	10	25
C60	£1.57	£3.00	£7.08
C90	£2.24	£4.25	£10.00
C120	£2.73	£5.17	£12.24

AUDIOTRONIC CrO2 CASSETTES

TYPE	5	10	25
CR60	£3.92	£7.72	£19.12
CR90	£5.32	£10.46	£25.22

AUDIOTRONIC 8 TRACK CARTRIDGES

TYPE	Each	5	10
40M	85p	£4.00	£7.50
80M	£1.15	£5.40	£10.25

P&P Cassettes 3p, Cartridges 5p each OVER 10 of either POST FREE!

AUDIOTRONIC AHA101 Stereo Headphone Amplifier

All silicon, transistor amplifier operates from magnetic, ceramic or tuner inputs with twin stereo headphone outputs and separate volume controls for each channel. Operates from 9V battery. INPUTS: 5mV and 100mV. OUTPUT: 50mV per channel.

OUR PRICE £8.50 P&P 20p

EA41 REVERBERATION AMPLIFIER

Self contained, transistorised, battery operated. Simply plug in microphone, guitar etc. and output to your amplifier. Volume control and depth of reverberation control. Beau-walnut cabinet. 184 x 77 x 108mm.

OUR PRICE £7.50 P&P 20p

ALL PRICES EXCLUDE VAT

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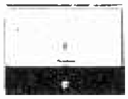
USED EXTENSIVELY BY INDUSTRY, GOVERNMENT DEPARTMENTS, EDUCATIONAL AUTHORITIES ETC.

Over 200 ranges in stock—other ranges to order. Quantity discounts available. Send for fully illustrated brochure.

CLEAR PLASTIC MODEL SD640
Size: 85 x 64mm

50uA	£3.80
100uA	£3.75
200uA	£3 70
500uA	£3.65
50-0-50uA	£3.75
100-0-100uA	£3 70
1mA	£3.65
5mA	£3.65
10mA	£3.65
50mA	£3.65
100mA	£3.65
500mA	£3.65
1A DC	£3.65
5A DC	£3.65
10A DC	£3.65
5V DC	£3 65
10V DC	£3.65
20V DC	£3 65
50V DC	£3 65
300V DC	£3 65
15V AC	£3 75
300V AC	£3.75
VU Meter	£3.90

CLEAR PLASTIC MODEL SW100
Size: 100 x 80mm



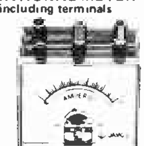
50uA	£4 60
100uA	£4.50
500uA	£4.30
50-0-50uA	£4.50
100-0-100uA	£4 45
1mA	£4.30
1A DC	£4.30
5A DC	£4.30
20V DC	£4.30
50V DC	£4.30
300V DC	£4 30
150V AC	£4.45
300V AC	£4 45
VU Meter	£4 90

EDGWISE MODEL PE70
Size: 90 x 34mm

50uA	£4.15
100uA	£4.10
200uA	£4 05
500uA	£3 90
50-0-50uA	£4 10
100-0-100uA	£4 05
1mA	£3 85
300V AC	£3 95
VU Meter	£4 30

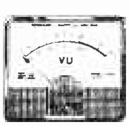
MODEL ED107 EDUCATIONAL METER
Size: 100 x 90 x 150mm including terminals

A range of high quality moving coil instruments ideal for school experiments and other bench applications. 3" mirror scale. The meter movement is easily accessible to demonstrate internal working.



50uA	£8 50
100uA	£7 90
50-0-50uA	£7 90
1mA*	£7.60
1-0-1mA	£7.60
1A DC	£7.60
5A DC	£7 60
5V DC	£7 60
10V DC	£7 60
15V DC	£7 60
20V DC	£7 60
50V DC	£7 60
300V DC	£7 60
500mA/5A DC	£8 60
5V/50V DC	£8 60
5V/15V DC	£8 60
1/5A DC	£8.60
1A/15A DC	£8 60

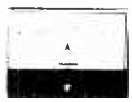
CLEAR PLASTIC MODEL MR 85P
Size: 120 x 110mm



50uA	£5 45
100uA	£5 40
200uA	£5 35
500uA	£5.25
50-0-50uA	£5 40
100-0-100uA	£5.35
500-0-500uA	£5.20
1mA	£5.20
1-0-1mA	£5 20
5mA	£5 20
10mA	£5 20
50mA	£5 20
100mA	£5.20
500mA	£5.20
1A DC	£5 20
5A DC	£5 20
15A DC	£5 20
30A DC	£5 40
10V DC	£5.20
20V DC	£5.20
50V DC	£5 20
150V DC	£5.20
300V DC	£5 20
15V AC	£5 30
300V AC	£5 30
S Meter 1mA	£5 20
VU Meter	£5 55
1A AC	*£5 20
5A AC	*£5 20
10A AC	*£5.20
20A AC	*£5.20
30A AC	*£5 20

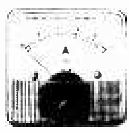
*Items with asterisk are Moving Iron type, all others are Moving Coil

CLEAR PLASTIC MODEL SD830
Size: 110 x 83mm



50uA	£4 30
100uA	£4 25
200uA	£4.20
500uA	£4.15
50-0-50uA	£4.25
100-0-100uA	£4 20
1mA	£4 10
5mA	£4 10
10mA	£4 10
50mA	£4.10
100mA	£4 10
500mA	£4 10
1A DC	£4 10
5A DC	£4 10
10A DC	£4 10
5V DC	£4 10
10V DC	£4.10
20V DC	£4 10
50V DC	£4 10
300V DC	£4 10
15V AC	£4 20
300V AC	£4 20
VU Meter	£4 40

CLEAR PLASTIC MODEL MR 45P
Size. 50 x 50mm



50uA	£3 20
100uA	£3.15
200uA	£3 10
500uA	£3 00
50-0-50uA	£3 15
100-0-100uA	£3 10
500-0-500uA	£2 95
1mA	£2 95
5mA	£2 95
10mA	£2 95
50mA	£2 95
100mA	£2 95
500mA	£2 95
1A DC	£2.95
5A DC	£2 95
10V DC	£2 95
20V DC	£2 95
50V DC	£2 95
300V DC	£2 95
15V AC	£3 05
300V AC	£3 05
S Meter 1mA	£2 95
VU Meter	£3 40
1A AC	*£2 95
5A AC	*£2 95
10A AC	*£2 95
20A AC	*£2 95
30A AC	*£2 95

CLEAR PLASTIC MODEL MR 38P
Size: 42 x 42mm

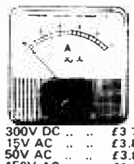
50uA	£3 10
100uA	£3 05
200uA	£3 00
500uA	£2 85
50-0-50uA	£3 05
100-0-100uA	£3 00
500-0-500uA	£2 80
1mA	£2 80
1-0-1mA	£2 80
2mA	£2.80
5mA	£2 80
10mA	£2 80
20mA	£2.80
50mA	£2.80
100mA	£2 80
150mA	£2 80
200mA	£2 80
300mA	£2 80
500mA	£2 80
750mA	£ 280
1A DC	£2 80
2A DC	£2 80
5A DC	£2.80
10A DC	£2 80
3V DC	£2 80
10V DC	£2 80
15V DC	£2 80
20V DC	£2 80
50V DC	£2 80
100V DC	£2 80
150V DC	£2 80
300V DC	£2 85
500V DC	£2 85
750V DC	£2 90
15V AC	£2 90
50V AC	£2 90
150V AC	£2 90
300V AC	£2 90
500V AC	£3 00
S Meter 1mA	£2 80
VU Meter	£3 20

CLEAR PLASTIC MODEL SD460
Size: 59 x 46mm

50uA	£3 50
100uA	£3 45
200uA	£3 40
500uA	£3 35
50-0-50uA	£3 45
100-0-100uA	£3 40
1mA	£3 30
5mA	£3 30
10mA	£3 30
50mA	£3 30
100mA	£3 30
500mA	£3.30
1A DC	£3 30
5A DC	£3 30
10A DC	£3 30
5V DC	£3 30
10V DC	£3.30
20V DC	£3 30
50V DC	£3 30
300V DC	£3 30
15V AC	£3 45
300V AC	£3 45
VU Meter	£3 65

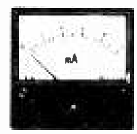
POSTAGE & PACKING 15p

CLEAR PLASTIC MODEL MR 65P
Size: 86 x 78mm



50uA	£3 95
100uA	£3.85
200uA	£3 80
500uA	£3 75
50-0-50uA	£3 85
100-0-100uA	£3.80
500-0-500uA	£3.70
1mA	£3.70
1-0-1mA	£3.70
5mA	£3.70
10mA	£3 70
50mA	£3 70
100mA	£3.70
500mA	£3.70
1A DC	£3.70
5A DC	£3.70
10A DC	£3 70
15A DC	£3 70
20A DC	£3.80
30A DC	£3 85
50A DC	£4 05
5V DC	£3 70
10V DC	£3 70
15V DC	£3.70
20V DC	£3 70
50V DC	£3 70
150V DC	£3 70
300V DC	£3 70
15V AC	£3.80
50V AC	£3.80
150V AC	£3.80
300V AC	£3.90
500V AC	£3.80
S Meter 1mA	£4 10
VU Meter	£3 70
1A AC	*£3.70
5A AC	*£3.70
10A AC	*£3.70
20A AC	*£3.70
30A AC	*£3.70
50mA AC	*£3 70
100mA AC	*£3 70
200mA AC	*£3 70
500mA AC	*£3 70

BAKELITE MODEL S80 Enlarged Window
Size: 80 x 80mm

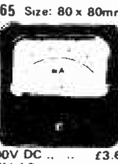


50uA	£4.50
100uA	£4.45
500uA	£4 20
50-0-50uA	£4.45
100-0-100uA	£4.40
1mA	£4 20
1A DC	£4 20
5A DC	£4 20
20V DC	£4.20
50V DC	£4 20
300V DC	£4.20
300V AC	£4.30
VU Meter	£4.70

CLEAR PLASTIC MODEL MR 52P
Size: 60 x 60mm

50uA	£3 70
100uA	£3.50
500uA	£3 35
50-0-50uA	£3.50
100-0-100uA	£3 45
1mA	£3 30
5mA	£3.30
10mA	£3 30
50mA	£3 30
100mA	£3 30
500mA	£3 30
1A DC	£3 30
5A DC	£3 30
10V DC	£3 30
20V DC	£3.30
50V DC	£3 30
300V DC	£3 30
15V AC	£3 40
300V AC	£3.40
S Meter 1mA	£3 30
VU Meter	£3 80
1A AC	*£3.3C
5A AC	*£3.30
10A AC	*£3.30
20A AC	*£3.30
30A AC	*£3.30

BAKELITE MODEL MR 65 Size: 80 x 80mm



25uA	£5 25
50uA	£4 00
100uA	£3.95
500uA	£3.65
50-0-50uA	£3.95
100-0-100uA	£3.90
500-0-500uA	£3.60
1mA	£3.60
1-0-1mA	£3 60
5mA	£3 60
10mA	£3.60
50mA	£3 60
100mA	£3 60
500mA	£3 60
1A DC	£3 60
2A DC	£3 60
5A DC	£3.60
10A DC	£3.60
15A DC	£3.60
30A DC	£3.60
50A DC	£3.80
5V DC	£3.60
10V DC	£3 60
15V DC	£3.60
20V DC	£3 60
50V DC	£3 60
150V DC	£3 60
300V DC	£3.60
30V AC	*£3.60
50V AC	*£3 60
150V AC	*£3.60
300V AC	*£3 60
500V AC	*£3 60
VU Meter	£4 10
1A AC	*£3.60
5A AC	*£3 60
10A AC	*£3 60
20A AC	*£3 60
30A AC	*£3 60
50A AC	*£3 60
500mA AC	*£3 60
50mV DC	£3 75
100mV DC	£3 75

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PW7

Another winner! fane MODE ONE HIGH FIDELITY LOUDSPEAKER KIT

Recommended retail price

£10·98

including V.A.T.

Consisting of a Fane Model 803 ultra-low resonance 8″ speaker unit with PVC cone surround, and a Fane Model 303 high frequency pressure tweeter together with a printed circuit cross-over assembly with ferrite cored coils.

SPECIFICATION OF UNITS

	Model 803	Model 303
Overall Diameter	8″	3″
Natural resonance	30Hz	—
Main resonance	*35Hz	1200Hz
Magnet Pole Diameter	1″	¾″
Magnet Flux Density	13,000 gauss	10,000 gauss
Frequency response	30Hz–8kHz	2kHz–17kHz
Impedance	8–15 ohms	8–15 ohms
Power Handling	*15 watts	*15 watts

Very easy to assemble, this boxed kit comes with acoustic foam damping material, panels, screws, wire, wiring diagrams and instructions to provide a remarkable loudspeaker assembly—a pair is ideal for stereo.

CABINETS for the 'Mode One' are available in Teak veneer finish. SIZE 15¼″ x 10¼″ x 9″.

**When used with above cabinet.*

Please send S.A.E. for fully descriptive leaflet.

Distributors to the wholesale and retail trade
LINEAR PRODUCTS LTD.
Electron Works, Armley, Leeds LS12 3SA. Tel. 630126

Manufactured by
FANE ACOUSTICS LTD.
Hick Lane, Batley, Yorkshire.
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AERIAL MAST POLES. Approx. 5ft. 2in. high, 2in. dia. Interlocking ends. Minimum order 3. As new, £1·25 (each) P. & P. 40p each.

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PAIR OF 4 × 150A VALVES complete with bases ex-equip not tested. Good condition £3, P. & P. 30p.

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FANTASTIC BARGAIN. New 6 inch tubes. E450 4/B/16 4VH, medium Persistance, green. Ideal scope tube.

Also 7BP7. All unused as new. Price £2 post paid.

TRANSISTOR BOARDS—consisting of transistors, diodes and resistors etc. Long leads. Good value 12 for £1·00 (min. order) P. & P. 30p. Quotations for quantity.

OUR SELECTION OF 6–Ex. Equ. METERS consisting of 3in., 2½in., 2in. mill amps, volts, amps. Mixed at the bargain price of £2·20 P. & P. 30p. minimum order of six.

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AERIAL POLES 4ft high 2″ in diameter push-in type as new £1 each p. & p. 25p each minimum four.

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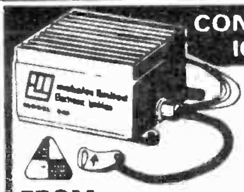

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STEREO AND MONO

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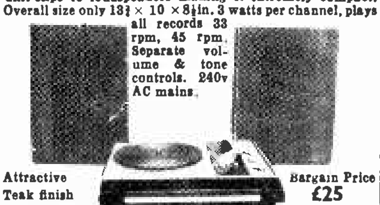
Modern design. Black rexine covered Silver front grille. Chrome fittings. Motor board cut for BSR deck. **£4·50** Post 35p.

COMPACT PORTABLE STEREO HI-FI

Two full size loudspeakers 13½ × 10 × 3¼in. Player unit clips to loudspeakers making it extremely compact. Overall size only 13½ × 10 × 8½in. 3 watts per channel, plays all records 33 rpm, 45 rpm. Separate volume & tone controls. 240v AC mains.



Attractive Teak finish Weight 13lbs. Bargain Price **£25** 85p carriage

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Single pole two-way. Surface mounting with fixing screws. Will replace existing wall switch to give light for return home, garage, automatic anti-burgular lights, etc. Variable knob Turn on or off at full or intermediate settings. Makers last list price £4·50. Brand new and fully guaranteed. Fully insulated. OUR PRICE £1·65 Post 25p

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5 K. ohms to 2 Meg. LOG or LIN. L/S 15p. D.P. 25p. STEREO L/S 55p. D.P. 75p. Edge 5K.S.P. Transistor 25p

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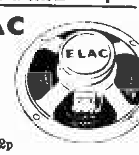
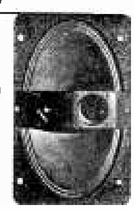
8in & 10 x 6in ELAC HI-FI SPEAKER



Dual cone plasticised roll surround. Large ceramic magnet. 50-16,000 c/s. Bass resonance 55 c/s. 8 ohm 10 watt. **£3·75** Each Post 52p

10 inch 12 watt £4·50

E.M.I. 13½ × 8in. SPEAKER SALE!



With twin tweeters and crossover, 10 watt. State 3 or 8 or 15 ohm. (As illustrated) **£4·50** Post 25p

With flared tweeter cone and ceramic magnet. 10 watt. Bass res. 45-60 c/s. Flux 10,000 gauss. State 3 or 8 or 15 ohm. Post 25p **£2·75**

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ELAC 9 × 5in. HI-FI SPEAKER. TYPE 59RM. THIS FAMOUS AND WIDELY USED UNIT NOW AVAILABLE AT BARGAIN PRICE £3·30.
10 WATT, 8 OHM. CERAMIC MAGNET.

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Woofer 10½ × 6½in. Ceramic Magnet, 44oz. 13,000 lines. Tweeter 3½in. square, 10,000 lines. Crossover condenser full instructions supplied. Impedance 8 ohms. Power 12 watts. **£6·75** Post 45p.

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3 amp, 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 £6·00
5 amp. 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 £9·75
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32/450V 35p	1000/50V .. 47p	32+32/450V .. 60p
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Post free
30-14,500 c/s, 12in. double cone, woofer and tweeter cone together with a BAKER ceramic magnet assembly having a flux density of 14,000 gauss and a total flux of 145,000 Maxwells. Bass resonance 40 c/s Rated 20 watts. NOTE: 3 or 8 or 15 ohms must be stated.

Module kit, 30-17,000 c/s with tweeter, crossover, baffle and instructions. Post free **£12·50**
Please state 3 or 8 or 15 ohms.

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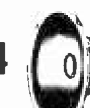
'Group 25'	'Group 35'	'Group 50'
12 inch 25 watt **£8·80**	12 inch 35 watt **£9·90**	15 inch 50 watt **£22**
3 or 8 or 15 ohm	3 or 8 or 15 ohm	8 or 15 ohm

TEAK VENEERED HI-FI SPEAKER CABINETS
For 12in. or 10in. dia. speaker 20 × 13 × 9" £10·50 Post 25p
For 13 × 8in. or 8in. speaker 16 × 10 × 9" £6·60 Post 25p
For 8 × 5in. speaker 16 × 8 × 6" £4·95 Post 25p
For 6in. and tweeter 12 × 8 × 6" £4·00 Post 25p
LOUDSPEAKER CABINET WADDING 18in. wide, 15p ft

EMI 6½in. HI-FI WOOFER



8 ohm, 10 watt. Large ceramic magnet. Special Rubber cone surround. Frequency response 30-12,000 c/s. Ideal P.A. Columns, Hi-Fi Enclosure Systems, etc. Suitable cabinet 12 × 8 × 6 £4·00. Suitable Tweeter £2·00. **£4**

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The moving coil diaphragm gives a good radiation pattern to the higher frequencies and a smooth extension of total response from 1,000 c/s to 18,000 c/s. Size 3½ × 3½ × 2in. deep. Rating 10 watt, 8 ohm Suitable Crossover £1·30 **£1·90** Post 20p

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All purpose transistorised. Ideal for Groups, Disco and P.A. 4 inputs speech and music. 4 way mixing. Output 8/15 ohm. a.c. Mains. Separate treble and bass controls. **£49** Carr. £1·00
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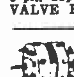
BARGAIN 4 CHANNEL TRANSISTOR MONO MIXER. Add musical highlights and sound effects to recordings. Will mix Microphone, records, tape and tuner with separate controls into single output. 9 volt. **£4·50**

TWO CHANNEL STEREO VERSION **£5·95**

BARGAIN 3 WATT AMPLIFIER. 4 Transistor Push-Pull Ready built, with volume, treble and bass controls 18v. DC operation. **£4·50**

COAXIAL PLUG 10p. PANEL SOCKETS 10p. LINE 18p COAXIAL OUTLET BOXES, surface, 35p. BALANCED TWIN FEEDER 300 ohms 5p yard. JACK SOCKET Std. open-circuit 14p, closed-circuit 23p. Chrome Lead Socket 45p. Phono Plugs 5p. Phono Socket 5p. JACK PLUGS Std. Chrome 20p; 3·5mm Chrome 12p. DIN SOCKETS Chassis 3-pin 10p; 5-pin 10p. DIN SOCKETS Lead 3-pin 18p; 5-pin 25p. DIN PLUGS 3-pin 18p; 5-pin 25p. VALVE HOLDERS. 5p; CERAMIC 10p; CANS 5p.

REVERSIBLE 4 POLE MOTOR £2·25



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Sinclair Project 80

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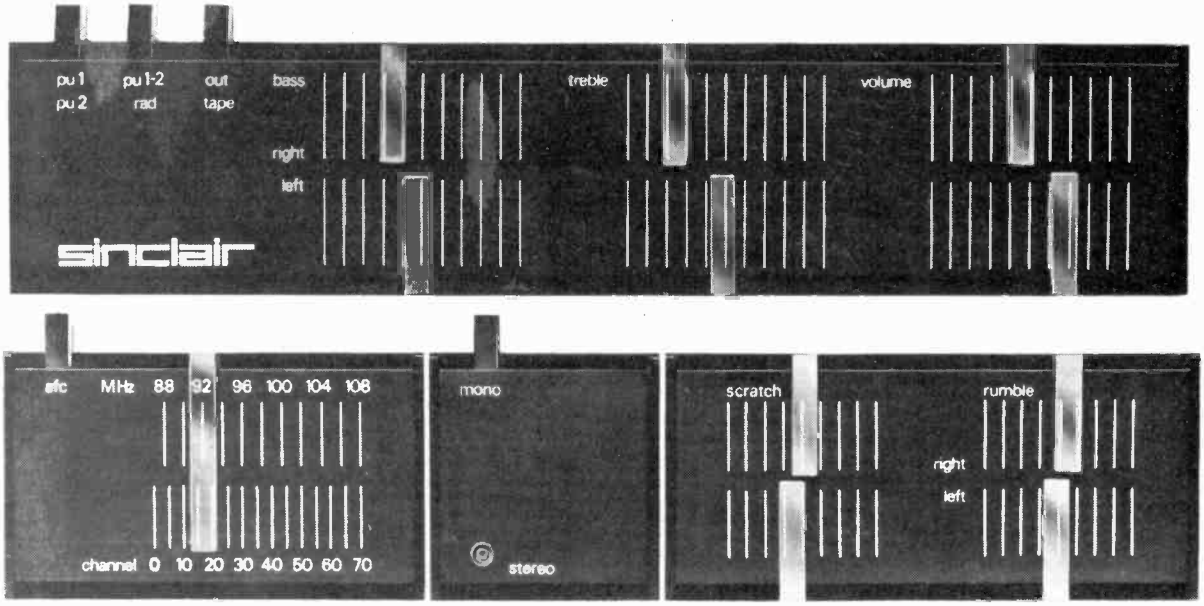


only $\frac{3}{4}$'' deep x 2'' high

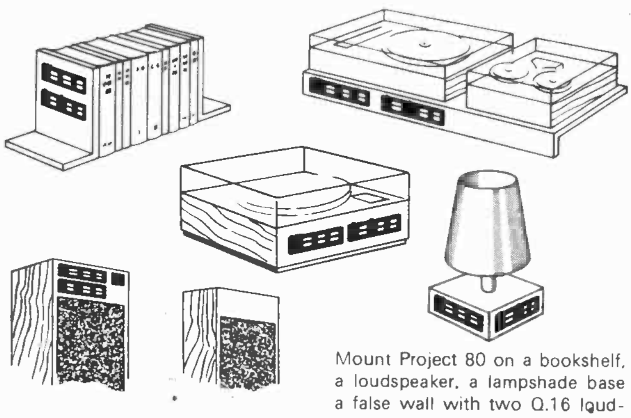
Living with hi-fi takes on new meaning with Sinclair Project 80. The electronics of these revolutionary new modules are all contained within elegantly designed matching cases no more than three-quarters of an inch deep. They are designed for mounting on any appropriate flat surface by means of 6BA bolts extending from the rear of each module and which pass through suitably drilled holes. Connections are taken away out of sight in a similar manner. The possibilities opened up by Project 80 are endless – superb hi-fi systems can be installed in ways hitherto only dreamed about and never before made practical. No more cutting out and shaping to put modules in position. A few holes drilled with the aid of templates supplied and the job is done. Now you need never again be faced with problems of keeping the hi-fi from clashing with carefully thought-out furnishing schemes. (That will surely please wives!) Slider controls have been introduced in place of knobs and all modules in the range incorporate new up-dated circuitry with emphasis on performance standards and built-in protection against overload and shorting. The aim was to re-think modular construction completely – to make it infinitely more versatile, even simpler and more reliable – the result – Project 80 – another triumph for Sinclair, and the most exciting construction modules ever.

the slimmest, most elegant hi-fi modules ever made

Typical Project 80 applications

System	The Units to use	Units cost
Simple battery record player	Z.40	£5·45 + 54p V.A.T.
Mains powered record player	Z.40, PZ.5	£10·43 +£1.04 V.A.T.
30W. RMS continuous sine wave stereo amp.	2 × Z.40s, Stereo 80; PZ.6	£30·83 +£3.08 V.A.T.
50W (8 Ω) RMS continuous sine wave de luxe stereo amp.	2 × Z.60s, Stereo 80; PZ.8	£33·83 +£3.38 V.A.T.
Indoor P.A.	Z.60, PZ.8	£14·93 +£1.49 V.A.T.

Project 80 FM tuner, decoder, and A.F.U. may be added as required



Mount Project 80 on a bookshelf, a loudspeaker, a lampshade base a false wall with two Q.16 loudspeakers . . . almost anywhere.

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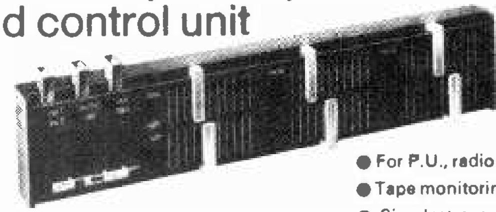
Stereo 80 pre-amplifier and control unit



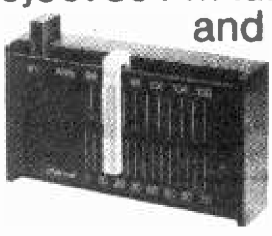
- For P.U., radio and tape
- Tape monitoring switch
- Simplest ever fixing

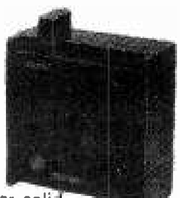
Each channel has its own separate tone and volume controls operated by sliders, enabling ideal environmental matching to be obtained. A virtual earth input stage forms part of the up-dated circuitry that ensures the finest possible quality from all signal sources. Generous overload margins are allowed on all inputs. Clear instructions with template are supplied.

TECHNICAL SPECIFICATIONS
Size – 260 × 50 × 20mm (10¼ × 2 × ¾ins)
Finish – Black with white indicators and transparent sliders
Inputs – Magnetic pick-up 3mV RIAA corrected; Ceramic pick-up 300mV
Radio 300mV; Tape 30mV
Signal/noise ratio – 60dB
Frequency range – 20Hz to 15KHz ± 1dB. 10Hz to 25KHz ± 3dB
Power requirements – 20 to 35 volts
Outputs – 100mV + AB monitoring for tape
Controls – Press button for tape radio and P.U Sliders for volume, bass (+ 12dB to – 14dB at 100Hz) treble (+ 11dB to – 12dB at 10KHz)

R.R.P. **£11.95** +£1·19 V.A.T.

Project 80 FM tuner and stereo decoder





- Twin dual varicap tuning: 4 pole ceramic filter: switchable A.F.C.
- On the decoder, solid state stereo indicating beacon.

Making the Project 80 F.M. tuner and decoder available separately gives a wider choice of systems and saves money where stereo reception may not be required. The tuner is a triumph of electronic design and assures excellent performance. The decoder gives a 40dB channel separation with 150mV output per channel. Both units may be used with other than Project 80 systems.

TECHNICAL SPECIFICATIONS OF TUNER
Size – 85 × 50 × 20mm (3½ × 2 × ¾ins)
Tuning range – 87·5 to 108 MHz
Detector – I.C. balanced coincidence for good A.M. rejection
One I.C. equal to 26 transistors
Distortion – 0·2% at 1 KHz for 30% modulation
4 pole ceramic filter in I.F. section
Aerial impedance – 75 Ω or 240-300 Ω
Sensitivity – 4 microvolts for 30dB quieting
Output – 300 mV for 30% modulation
Power requirements – 23 to 33 volts

R.R.P. **£11.95** +£1·19 V.A.T.

DECODER
Size – 47 × 50 × 20mm (1⅞ × 2 × ¾ins)
One 19 transistor I.C.

R.R.P. **£7.45** +0·74 V.A.T.

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If, within 3 months of purchasing any product direct from us, you are dissatisfied with it, your money will be refunded on production of receipt of payment. Many Sinclair appointed stockists also offer this guarantee. Should any defect arise in normal use, we will service it without charge.

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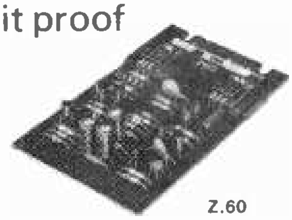
Z.40



Z.60

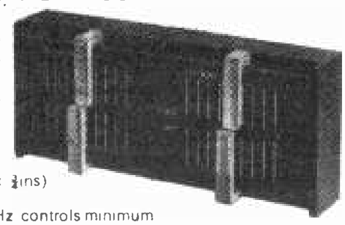
Intended for use in Project 80 installations, these modules readily adapt to an even wider range of applications. Both incorporate built-in protection against short circuiting and risk of damage from mis-use is greatly reduced.

Z.40 TECHNICAL SPECIFICATIONS
Size – 55 × 80 × 20mm (2¼ × 3¼ × ¾ins) 9 transistors
Input sensitivity – 100mV
Output – 15 watts RMS continuous into 8 Ω (35v)
Frequency response – 10Hz – 100KHz ± 1dB
Signal/noise ratio – 64dB
Distortion – at 10 watts into 8 Ω less than 0·1%
Power requirements – 12 to 35 volts

Z.60 TECHNICAL SPECIFICATIONS
Size – 55 × 98 × 15mm (2¼ × 3⅞ × ¾ins) 12 transistors
Input sensitivity – 100-250mV
Output – 25 watts RMS continuous into 8 Ω (45V).
Distortion – typically 0·03%
Frequency response – 10Hz to more than 200KHz ± 1dB
Signal/noise ratio – better than 70dB
Built-in protection against transient overload and short circuiting
Load impedance – 4 Ω min, max safe on open circuit

Z.40 R.R.P. **£5.45** + 0·54 V.A.T. **Z.60** R.R.P. **£6.95** + 0·69p V.A.T.

Project 80 active filter unit



Makes a highly desirable part of any worthwhile system where inputs may be from record, radio or tape. As with Stereo 80, separate controls applied to each channel make it easier to obtain ideal stereo balance.

TECHNICAL SPECIFICATIONS
Size – 108 × 50 × 20mm (4¼ × 2 × ¾ins)
Voltage gain – minus 0·2dB
Frequency response – 36Hz to 22KHz controls minimum
Distortion – at 1KHz – 0·03% using 30V supply
HF cut off (scratch) – 22KHz to 5·5KHz, 12dB/oct. slope
L.F. cut off (rumble) – 28dB at 20Hz, 9dB/oct slope

- For scratch and rumble control
- Transistorised active circuitry

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PZ.8

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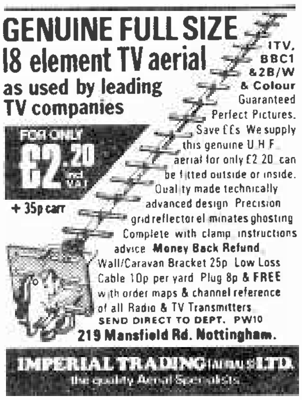

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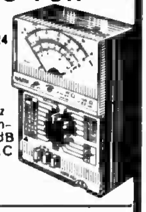

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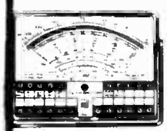

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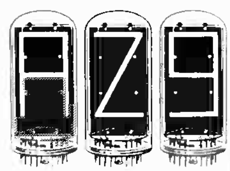

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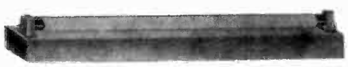

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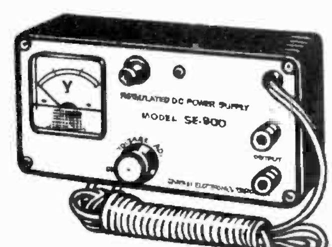

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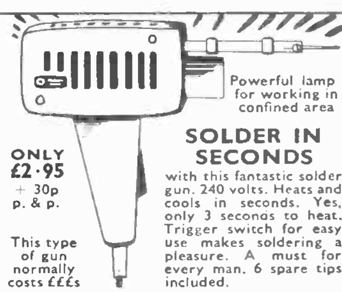

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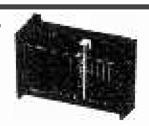

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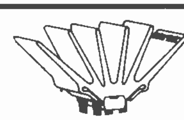

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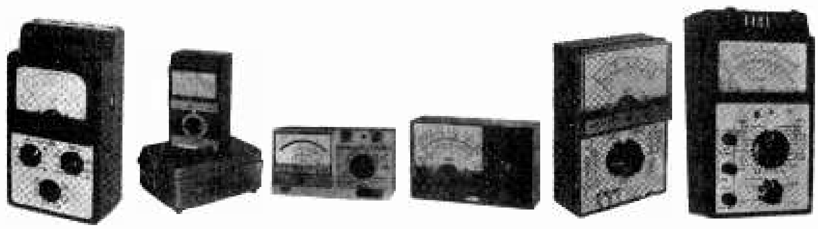

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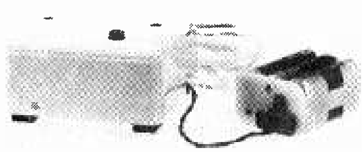

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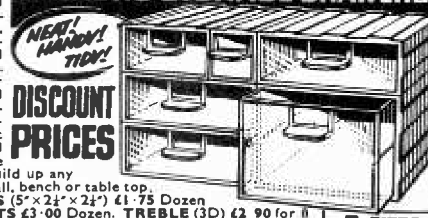

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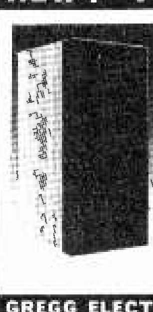

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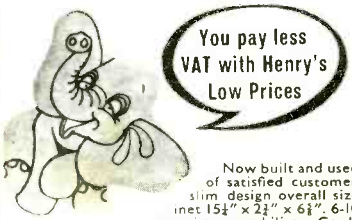

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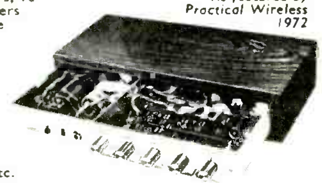

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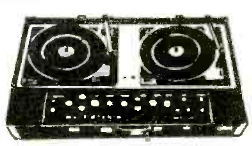

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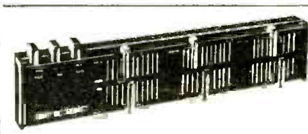

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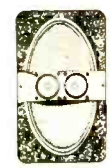

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